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ABSTRACT

This document is intended to help education and training institutions deliver the Machine Tool Advanced Skills Technology (MAST) curriculum to a variety of individuals and organizations. MAST consists of industry-specific skill standards and model curricula for 15 occupational specialty areas within the U.S. machine tool and metals-related industries. This volume provides the MAST standards and curriculum for the instrumentation specialty area. It is organized in the following sections: (1) a profile of Augusta Technical Institute (Georgia), the development center that produced these standards and curriculum; (2) an instrumentation and technician competency profile of job duties and tasks; (3) a technician duty, task, and subtask outline; (4) a course curriculum outline and course descriptions; (5) a technical workplace competencies and course crosswalk; and (6) a Secretary's Commission on Achieving Necessary Skills (SCANS) proficiencies course crosswalk. Individual syllabi for the following courses are provided: College Algebra; Composition and Rhetoric I; Computer Programming Fundamentals; Engineering Graphics I; College Trigonometry; Technical Communications; Mechanics; DC Circuit Analysis; Differential Calculus; Electricity and Magnetism; AC Circuit Analysis I; Electronic Devices; Fluids, Heat, Sound, and Light; AC Circuit Analysis II; Digital Fundamentals; Electromechanical Devices; Control Systems; Microcomputer Fundamentals; Programmable Controllers; Motor Controls; Introduction to Process Control; Control Systems II; Distributed Control Systems; and Introductory Psychology. Components of each syllabus are as follows: lecture, lab, and credit hours; course description; prerequisites; course objectives; required course materials; method of instruction; course objectives: technical competencies; and course objectives: SCANS competencies. Appendixes contain the individual competency profiles for each company surveyed by the MAST development center and narrative of the pilot program for this occupational specialty. (YLB)

ED 401 442

Machine Tool Advanced Skills Technology

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COMMON GROUND: TOWARD A STANDARDS-BASED TRAINING SYSTEM FOR THE U.S. MACHINE TOOL AND METAL RELATED INDUSTRIES

VOLUME 12

INSTRUMENTATION

of
a 15 volume set of Skills Standards
and
Curriculum Training Materials for the
PRECISION MANUFACTURING INDUSTRY

Supported by
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Moraine Valley Community College

SPRINGFIELD TECHNICAL COMMUNITY COLLEGE

Texas State Technical College Waco

Machine Tool Advanced Skills Technology Program

MAST

VOLUME 12

-- INSTRUMENTATION --

Supported by
The Office of Vocational and Adult Education
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- U.S. Department of Education, Office of Vocational & Adult Education
- MAST Consortia of Employers and Educators

MAST DEVELOPMENT CENTERS

Augusta Technical Institute - Itawamba Community College - Moraine Valley Community College - San Diego City College (CACT) - Springfield Technical Community College - Texas State Technical College

INDUSTRIES

AB Lasers - AIRCAP/MTD - ALCOA - American Saw - AMOCO Performance Products - Automatic Switch Company - Bell Helicopter - Bowen Tool - Brunner - Chrysler Corp. - Chrysler Technologies - Conveyor Plus - Darr Caterpillar - Davis Technologies - Delta International - Devon - D. J. Plastics - Eaton Leonard - EBTEC - Electro-Motive - Emergency One - Eureka - Foster Mold - GeoDiamond/Smith International - Greenfield Industries - Hunter Douglas - Industrial Laser - ITT Engineered Valve - Kaiser Aluminum - Krueger International. - Laser Fare - Laser Services - Lockheed Martin - McDonnell Douglas - Mercury Tool - NASSCO - NutraSweet - Rapistan DEMAG - Reed Tool - ROHR, International - Searle - Solar Turbine - Southwest Fabricators - Smith & Wesson - Standard Refrigeration - Super Sagless - Taylor Guitars - Tecumseh - Teledyne Ryan - Thermal Ceramics - Thomas Lighting - FMC, United Defense - United Technologies Hamilton Standard

COLLEGE AFFILIATES

Aiken Technical College - Bevil Center for Advanced Manufacturing Technology - Central Florida Community College - Chicago Manufacturing Technology Extension Center - Great Lakes Manufacturing Technology Center - Indiana Vocational Technical College - Milwaukee Area Technical College - Okaloosa-Walton Community College - Piedmont Technical College - Pueblo Community College - Salt Lake Community College - Spokane Community College - Texas State Technical Colleges at Harlington, Marshall, Sweetwater

FEDERAL LABS

Jet Propulsion Lab - Lawrence Livermore National Laboratory - L.B.J. Space Center (NASA) - Los Alamos Laboratory - Oak Ridge National Laboratory - Sandia National Laboratory - Several National Institute of Standards and Technology Centers (NIST) - Tank Automotive Research and Development Center (TARDEC) - Wright Laboratories

SECONDARY SCHOOLS

Aiken Career Center - Chicopee Comprehensive High School - Community High School (Moraine, IL) - Connally ISD - Consolidated High School - Evans High - Greenwood Vocational School - Hoover Sr. High - Killeen ISD - LaVega ISD - Lincoln Sr. High - Marlin ISD - Midway ISD - Moraine Area Career Center - Morse Sr. High - Point Lamar Sr. High - Pontotoc Ridge Area Vocational Center - Putnam Vocational High School - San Diego Sr. High - Tupelo-Lee Vocational Center - Waco ISD - Westfield Vocational High School

ASSOCIATIONS

American Vocational Association (AVA) - Center for Occupational Research and Development (CORD) - CIM in Higher Education (CIMHE) - Heart of Texas Tech-Prep - Midwest (Michigan) Manufacturing Technology Center (MMTC) - National Coalition For Advanced Manufacturing (NACFAM) - National Coalition of Advanced Technology Centers (NCATC) - National Skills Standards Pilot Programs - National Tooling and Machining Association (NTMA) - New York Manufacturing Extension Partnership (NYMEP) - Precision Metalforming Association (PMA) - Society of Manufacturing Engineers (SME) - Southeast Manufacturing Technology Center (SMTC)

MAST PROJECT EVALUATORS

Dr. James Hales, East Tennessee State University and William Ruxton, National Tooling and Machine Association (NTMA)

SPECIAL RECOGNITION

Dr. Hugh Rogers recognized the need for this project, developed the baseline concepts and methodology, and pulled together industrial and academic partners from across the nation into a solid consortium. Special thanks and singular congratulations go to Dr. Rogers for his extraordinary efforts in this endeavor.

This report is primarily based upon information provided by the above companies, schools and labs. We sincerely thank key personnel within these organizations for their commitment and dedication to this project. Including the national survey, more than 3,000 other companies and organizations participated in this project. We commend their efforts in our combined attempt to reach some common ground in precision manufacturing skills standards and curriculum development.

This material may be found on the Internet at **http://machinetool.tstc.edu**

CATALOG OF 15 VOLUMES

VOLUME 1	EXECUTIVE SUMMARY STATEMENT OF THE PROBLEM MACHINE TOOL ADVANCED SKILLS TECHNOLOGY PROJECT PROJECT GOALS AND DELIVERABLES PROJECT METHODOLOGY PROJECT CONCLUSIONS AND RECOMMENDATIONS APPENDICES
VOLUME 2	CAREER DEVELOPMENT GENERAL EDUCATION REMEDIATION
VOLUME 3	MACHINING - CORE COURSES (MAC)
VOLUME 4	MANUFACTURING ENGINEERING TECHNOLOGY (MET)
VOLUME 5	MOLD MAKING (MLD)
VOLUME 6	WELDING (WLD)
VOLUME 7	INDUSTRIAL MAINTENANCE (IMM)
VOLUME 8	SHEET METAL (SML) AND COMPOSITES (COM)
VOLUME 9	TOOL AND DIE (TLD)
VOLUME 10	COMPUTER-AIDED DRAFTING AND DESIGN (CAD)
VOLUME 11	COMPUTER-AIDED MANUFACTURING AND ADVANCED CNC (CNC)
VOLUME 12	INSTRUMENTATION (INT)
VOLUME 13	LASER MACHINING (LSR)
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VOLUME 12
INSTRUMENTATION AND CONTROL TECHNOLOGY

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FOREWORD

Under the threat of global competition, shrinking product life cycles, and higher product quality standards American manufacturing is turning towards electronic sophistication to increase productivity and precision and reduce costs. Robotics, computer controlled systems, and electronic instrumentation have entered the manufacturing workplace at a pace unparalleled in United States industrial history while human workers and the conventional machines they used to operate are departing at the same rate. The machine operator in American factories has become a vulnerable part of the sector and can only hope to survive by obtaining continued training in the new technologies which have revolutionized manufacturing.

Assessment of industry and educational strengths, weaknesses, and opportunities through the year 2000 by Augusta Technical Institute reveals that 95% of future jobs will go to individuals with advanced technical training. The majority of these jobs will require post-secondary education and skills training. Since less that 20% of the population will pursue four-year, post-secondary education, community colleges and similar training institutions will be tasked with training the remaining 80% of the population through technology-based training and literacy curricula.

A case in point is the emerging occupation of **Instrumentation and Control Technician**. The Instrumentation and Control Technician is the worker in a manufacturing plant who insures that all instrumentation and control components of the manufacturing process operate at maximum efficiency. The work of the Instrumentation and Control Technician blends the science of data acquisition and control of systems with use of electronics and digital computers. Dynamic evaluation, testing, controller tuning, and total system performance are his or her concern. The need for such workers is vital and varied. Instrumentation and Control Technicians can work in field technical sales, field service representation, instrumentation engineering, network systems, computer systems technology, and even some robotics interfacing. Industries such as oil, chemical, petro chemical, power, big manufacturing plants, water utilities, and even large municipalities with large power plants will likely face increasing need for instrumentation workers in the future.

Recognizing the need to increase the supply of new skilled workers in this and other occupations for the metal and metals-related industries, the U.S. Department of Education launched the Cooperative Demonstration Program (Manufacturing Technologies) as part of the National Skills Standards Act of 1994. The goal of the Department initiative was to foster the development and implementation of national skill standards and a training model for certificate and Associate of Science degree programs. In July 1994, a multi-state consortium of community colleges led by Texas State Technical College received a grant awarded by the Department under the initiative. The Machine Tool Advanced Skills Technology (MAST) consortium, which includes six of the nation's leading Advanced Technology Centers (ATCs), was formed to develop, test and disseminate industry-specific skill standards and model curricula for the U.S. machine tool industry over a two year period. As part of the MAST consortium, Augusta Technical Institute in Georgia was tasked with developing and piloting skill standards and model curricula in the technical area of Instrumentation and Control Technician.

After numerous interviews with practitioners from industry (see Appendix A) and discussions with educators, managers, supervisors, and others involved with machine related occupations and specifically instrumentation and control, the MAST consortia partners have agreed to present our definition of a Instrumentation and Control Technician as follows:

INSTRUMENTATION AND CONTROL TECHNICIAN: *The instrumentation and control technician will be able to troubleshoot, repair, calibrate, specify, and commission as required all instrumentation and control components relating to plant operations.*

Augusta Technical College's curricula for instrumentation and control technician is structured as a 24 course, two year course of study. Course diversity ranges from motor control and fluid mechanics to circuit analysis and differential calculus.

This volume contains the justification, documentation, and course syllabi for the courses recommended as minimum training for individuals desiring to become instrumentation and control technicians.

PARTNER OCCUPATIONAL SPECIALITY ASSIGNMENTS

Although each of the six partner college development centers possessed detailed expertise in each of the MAST 15 occupational specialities, a division of work was still very necessary to ensure completion of the project due to the enormity associated with industrial assessment and complete curriculum revision for each of the areas of investigation.

Each Collegiate Partner was responsible for development of a specialization component of the overall model. Information for the future direction of this specialization area was obtained from NIST Manufacturing Centers and/or national consortia, professional societies, and industrial support groups addressing national manufacturing needs. Each Collegiate Partner tested its specialization model utilizing local campus resources and local industry. Information gained from the local experience was utilized to make model corrections. After testing and modification, components were consolidated into a national model. These events occurred during the first year of the Program. During the second year of the Program, the national model was piloted at each of the Collegiate Partner institutions. Experience gained from the individual pilot programs was consolidated into the final national model.

What follows is a profile of the MAST development center which had primary responsibility for the compilation and preparation of the materials for this occupational specialty area. This college also had the responsibility for conducting the pilot program which was used as one of the means of validation for this program.

MAST DEVELOPMENT CENTER, AUGUSTA, GA
Advanced Manufacturing Technology Center
Augusta Technical Institute

Kenneth Breeden, Commissioner
Georgia Department of Technical and Adult Education
Jack Patrick, President
Augusta Technical Institute
Jim Weaver, Director
Advanced Manufacturing Technology Center

3116 Deans Bridge Road
Augusta, GA 30906
College phone: 706/771-4000, fax: 706/771-4016
Center phone: 706-771-4090, fax: 706/771-4091
e-mail: jweaver@augusta.net

Manufacturing in the Augusta Region

Augusta is the second largest city in Georgia and manufacturing represents the largest sector of the Augusta economy. The region is home to 810 manufacturers employing 89,717 people, an industrial base consisting of about 75% process control and 25% discrete parts production facilities. Major areas of emphasis for industry include technology transfer, factory floor training, and job certification programs. Growth of manufacturing in the region has been driven by Augusta's high tech development in electronics, process control, telecommunications, computers, medical services and instrumentation.

Augusta Technical Institute and Advanced Manufacturing Technology Center (AMTEC)

Augusta Technical Institute (ATI) is part of Georgia's Department of Technical and Adult Education system, serving a large percentage of the two-state Central Savannah River area through its main campus and satellite facilities. The student body includes vocational-technical and college prep students, as well as current workers seeking retraining or skills upgrade; ATI has long emphasized outreach and special attention to the needs of low income, rural and disadvantaged residents, as well as displaced workers, single parents, women in non-traditional fields, and the disabled. In 1983, the Institute used the opportunity to host one of Georgia's new regional advanced technology centers (ATC's) to streamline its technical programs and thereby help to ensure the future employability of its students. ATI's Advanced Manufacturing Technology Center (AMTEC) is designed to provide technology research and demonstration, industry assessments, technical consulting, and industry-specific contract training for the many established and emerging high tech companies in the Augusta region.

Development Team

- **Project Director:** Jim Weaver, PhD., Director of AMTEC, served as program director for the MAST project.
- **Subject Matter Expert**: Ronnie Lambert, MS, MAST Site Coordinator, had program responsibility for developing skill standards based on the industry skills verification process, as well as developing course curricula and program materials for the MAST pilot program in Industrial Maintenance Mechanic and Instrumentation Technician. Mr. Lambert has taught Industrial Maintenance Mechanic and Instrumentation for 32 years in colleges and industry across the Southeast.
- **Subject Matter Expert**: Bob Johnson, BS, Project Development, was responsible for developing skill standards for the MAST project. Mr. Johnson has 27 years of experience in process-related industry and training in both technical schools and industry; he is certified in many process-related specialty areas.

THE MAST COMPETENCY PROFILE

Development of Competency Profiles at each of the MAST sites began with visits to representative companies for the purpose of surveying expert workers within the industry and occupational areas under investigation. Each site began the survey process by asking a subject matter expert in the targeted technical area, generally a member of their faculty, to employ a modified version of the generally-accepted DACUM (Developing A Curriculum) method to categorize the major skills needed to work in the selected occupation. As source materials, the college instructors drew on their professional knowledge and experience of current and future industry requirements. The initial skill standards developed by the subject matter experts underwent numerous internal reviews and revisions within each site, assuming final form as a series of structured survey and interview statements designed to elicit a simple yes or no response.

To determine an appropriate survey sample, each site compiled a database of their region's small and medium-sized manufacturers and searched for companies likely to employ workers in the targeted occupational area. The resulting cross-industry samples were sorted further to achieve a balance of technological capability and workforce size; the sample companies within each region were then asked to participate in the project. Willing respondents were scheduled for interviews.

During the company interviews, MAST staff asked expert workers to identify the primary duties and tasks performed by a typical worker and to consider the special skills and knowledge, traits and attitudes, and industry trends that will have an impact on worker training, employability, and performance both now and in the future. The interview results were analyzed to create individual profiles identifying the most common duties and skills required of workers at each company. Copies of individual company competency profiles are provided in Appendix A of this volume. These individual company Competency Profiles served two purposes. First, they showed, in a format that could be easily understood by both industry and educators, a picture of the occupational specialty at a given company at that particular time. Second, these individual company Competency Profiles furnished the company with a document for which they could claim ownership. This, in effect, made them "real" partners in the work of MAST.

Data for all companies were then aggregated to develop a composite Competency Profile of industry skill standards within the selected occupational specialty area of, as shown in the following pages.

These same duties and tasks were then included in both the Texas and National Surveys for further validation (see Volume 1). As a result of the surveys, additional refinements were made to the Competency Profiles. These changes were then incorporated into the individual course syllabi which were used for the pilot program.

The MAST Competency Profile for this occupational specialty area has been included on the following pages.

BASIC SKILLS AND KNOWLEDGE

Ability to Comprehend Written/Verbal Instructions
Ability to Work as Part of a Team
Communication Skills
Converse in the Technical Language of the Trade
Knowledge of Calibration Procedures
Knowledge of Company Policies/Procedures
Knowledge of Company Quality Assurance Activities
Knowledge of Employee/Employer Responsibilities
Knowledge of Occupational Opportunities
Knowledge of Safety Regulations
Mathematical Skills - Algebra & Trig
Mechanical Aptitude
Organizational Skills
Practice Quality-Consciousness in Performance of the Job
Practice Safety in the Workplace
Reading/Writing Skills
Use Inspection Devices
Use Pneumatic & Electronic Measurement Devices

AUGUSTA TECHNICAL INSTITUTE
MAST PROGRAM REPRESENTATIVES

DR. JIM WEAVER
Site Administrator
(706) 771-4089

RONNIE LAMBERT
Site Coordinator
(706) 771-4090

WILLIAM BECK
Department Head - Electromechanical Technology
(706) 771-4138

PREM IYER
Instructor - Electromechanical Technology
(706) 771-4144

PAMELA PHILLIPS
Secretary
(706) 771-4090

MARSHA HARRISON
Accounts Manager
(706) 771-4090

AMTEC

ATTITUDES AND TRAITS

Customer Relations
Dependability
Honesty
Interpersonal Skills
Neatness
Personal Ethics
Physical Ability
Professional
Punctuality
Responsible
Safety Conscientious
Self Motivation
Strong Work Ethic
Trustworthy

EQUIPMENT AND TOOLS

AC Solid State Drives
Air Analyzers
Calibrated Instruments (VOM, Pressure Supply)
Computer
Control Valves/Positioners
Controllers
P/I, I/P, Single Loop, Multiloop
Dampers
DC Solid State Drives
Digital Training Equipment
Electrical Training Equipment
Gas Analyzers
Gauges (Pressure, Limit, Flow)
Hand Tools
Ice Bath
Instrument Lab
Instrumentation Tech's Tools (Lab Calibrated against standard)
Instrumentation Training Equipment
Linear Variable Differential Transformer
Mass Flowmeters
Personal Safety Equipment
pH Analyzer
Programmable Controllers
Recorders/Indicators
Safety Training Equipment
Spectrometer
Strain Gauges
Transducers
Transmitters
Water Analyzers

CONCERNS AND FUTURE TRENDS

Advanced Computer Applications
Automated Material Handling Equipment
Computer Integrated Manufacturing
Distributed Control Systems
Environmental Concerns
Fiber Optic Controls
Robotics
Statistical Process Control

COMPETENCY PROFILE

INSTRUMENTATION TECHNICIAN

Prepared By
M.A.S.T.
Machine Tool Advanced Skills
Technology Program
and
Consortium Partners
(V.199J40008)

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

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INSTRUMENTATION AND CONTROL TECHNICIAN....will be able to troubleshoot, repair, calibrate, specify and commission as required all instrumentation and control components relating to overall power plant operations. This is to include dynamic evaluation, testing, controller tuning, and total system performance evaluations.

Tasks →

Duties													
A Practice Safety	A-1 Follow safety manuals and all safety regulations/ requirements	A-2 Use protective equipment	A-3 Follow safe operating procedures for hand and power tools	A-4 Maintain a clean and safe work environment									
B Maintain Control Systems	B-1 Proper storage of Circuit Boards	B-2 Collect and record data according to company requirements	B-3 Test and calibrate Transducers according to Specs	B-4 Perform preventive maintenance procedures for control devices	B-5 Test and/ or Replace Printed Circuit Boards	B-6 Function check individual elements within loop	B-7 Troubleshoot different types of system modules	B-8 Test different types of system modules	B-9 Configure Software	B-10 Repair different types of system modules	B-11 Install control system hardware	B-12 Simulate control system check	B-13 Loop-check control system
	B-14 Perform on-line testing	B-15 Troubleshoot and maintain PLCs and motor control systems											
C Maintain Field Instrumentation Devices	C-1 Test and calibrate pressure,level,flow, and temperature switches	C-2 Troubleshoot and repair pres.,level,flow, & temp. sw.	C-3 Adjust dampers and positioners	C-4 Troubleshoot and adjust control drive (damper)	C-5 Test and calibrate indicators and gauges	C-6 Troubleshoot and repair indicators	C-7 Test and calibrate transmitters	C-8 Test and calibrate recorders	C-9 Troubleshoot and repair recorders	C-10 Troubleshoot linear variable differential transformers	C-11 Troubleshoot, repair, and calibrate transmitters	C-12 Test different field sensing elements-flow,temp,pres,level	C-13 Install/ replace field sensing elements
	C-14 Troubleshoot and repair transmitters	C-15 Tune controllers: pneumatic and electronic	C-16 Troubleshoot and repair plant computing systems relate to process controls	C-17 Troubleshoot and repair solenoid valves	C-18 Perform preventive maintenance procedures for field devices	C-19 Test and repair thermocouple	C-20 Check and test vibration sensing elements	C-21 Inspect and troubleshoot power supplies and converters	C-22 Test and calibrate control valve actuators	C-23 Troubleshoot and repair control valves/ positioners	C-24 Test and calibrate controllers	C-25 Troubleshoot and repair local controllers	C-26 Troubleshoot and repair electronic computing relays
	C-27 Troubleshoot and repair analyzers	C-28 Test and calibrate air analyzers	C-29 Test and calibrate water analyzers	C-30 Troubleshoot servo valves	C-31 Calibrate servo valves	C-32 Test and clean video display unit	C-33 Check and adjust video display unit	C-34 Design, specify and configure smart field devices, i.e., transmitters and valves	C-35 Operate control systems including single element, cascade, ratio, and feedforward	C-36 Test and calibrate gas analyzers			
D Organize Work Routines	D-1 Organize documents and drawings required on the job	D-2 Determine proper tools/ equipment/ materials to perform the job	D-3 Coordinate work activities with other crafts/ units	D-4 Coordinate preventive maintenance schedule with planning group	D-5 Verify equipment isolation prior to performance of work for safety reasons	D-6 Report abnormal equipment problems to supervisor	D-7 Write new calibration procedures if needed	D-8 Follow Specifications	D-9 Perform Algebraic Operations	D-10 Perform Trigonometric Functions	D-11 Perform Calculus Operations		
E Collect and File Data	E-1 Record test/calibration data	E-2 Record preventive maintenance data	E-3 Record equipment disconnect data	E-4 Evaluate collected data	E-5 Review/ revise procedures if needed	E-6 Write reports required by company	E-7 Specify equipment for control systems	E-8 Prepare and update specification forms	E-9 Write work orders	E-10 Prepare and update ladder and/or logic diagrams	E-11 Program PLCs		
F Participate in Continuing Education Activities	F-1 Read/ interpret diagrams and drawings	F-2 Sketch diagrams	F-3 Study technical equipment information	F-4 Application of ISA/IIC standards	F-5 Understand proper use of test equipment and tools	F-6 Learn to write technical reports	F-7 Acquire safe practices for handling hydraulic and special tools	F-8 Utilize technical manuals	F-9 Understand personal computers	F-10 Attend on-going safety training courses	F-11 Participate in plant related training	F-12 Attend PLC training	F-13 Attend DCS training

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Duties	Tasks →												
G — Maintain and Control Inventory	G-1 Learn to review and forecast spare parts inventory	G-2 Prepare parts request	G-3 Verify parts received	G-4 Research/ verify substitute specifications									
H — Troubleshoot, Install, Maintain and Operate Motor Control Systems	H-1 Trouble-shoot, install, mmaintain, and operate motor starters	H-2 Trouble-shoot, install, maintain, and operate relays	H-3 Trouble-shoot, install, maintain, and operate pushbuttons	H-4 Trouble-shoot, install, maintain, and operate switches	H-5 Trouble-shoot, install, maintain, and operate PLC systems, i.e. PLC and DCS Networks								

THE MAST TECHNICAL WORKPLACE COMPETENCY OUTLINE

The Competency Profiles derived from the industry survey process were returned to industry and faculty members at each MAST partner college for review. Reviewers were asked to identify specific sub-tasks within each block of Duties and Tasks in the Profile; MAST staff at each college broke the sub-tasks down further into the detailed steps required to actually perform the duties and tasks of the manufacturing process. It is these detailed skill standards that were then incorporated into development of the curriculum and piloted as a training program by each of the MAST colleges. All results for the specific occupational specialty area have been organized as an outline of the duties, tasks, and sub-tasks required to demonstrate technical competency in the workplace, as shown in the following pages.

As a result of the Texas and the National Surveys, additional refinements were made to the Competency Outlines. These changes were then incorporated into the individual course syllabi.

The MAST Technical Workplace Competency Outline for this occupational specialty area has been included on the following pages.

INSTRUMENTATION AND CONTROL TECHNICIAN
TECHNICAL WORKPLACE COMPETENCIES

INSTRUMENT AND CONTROL TECHNICIAN...*will be able to troubleshoot, repair, calibrate, specify and commission as required all instrumentation and control components relating to overall plant operations. This is to include dynamic evaluation, testing, controller tuning, and total system performance evaluations.*

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment
   c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Proper Storage of Circuit Boards
2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
14. Perform On-Line Testing
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES

1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Adjust Dampers and Positioners
4. Troubleshoot and Adjust Control Drive (Damper)
5. Test and Calibrate Indicators and Gauges
6. Troubleshoot and Repair Indicators
7. Test and Calibrate Transmitters
8. Test and Calibrate Recorders
9. Troubleshoot and Repair Recorders
10. Troubleshoot Linear Variable Differential Transformers
11. Troubleshoot, Repair, and Calibrate Transmitters
12. Test Different Field Sensing Elements
    a. flow
    b. temperature
    c. pressure
    d. level
13. Install/Replace Field Sensing Elements
14. Troubleshoot and Repair Transmitters
15. Tune Controllers: Pneumatic and Electronic
16. Troubleshoot and Repair Plant Computing Systems Relating to Process Controls
17. Troubleshoot and Repair Solenoid Valves
18. Perform Preventive Maintenance Procedures for Field Devices
19. Test and Repair Thermocouples
20. Check and Test Vibration Sensing Elements
21. Inspect and Troubleshoot Power Supplies and Converters
22. Test and Calibrate Control Valve Actuators
23. Troubleshoot and Repair Control Valves/Positioners
24. Test and Calibrate Controllers
25. Troubleshoot and Repair Local Controllers
26. Troubleshoot and Repair Electronic Computing Relays
27. Troubleshoot and Repair Analyzers
28. Test and Calibrate Air Analyzers
29. Test and Calibrate Water Analyzers
30. Troubleshoot Servo Valves
31. Calibrate Servo Valves
32. Test and Clean Video Display Unit
33. Check and Adjust Video Display Unit
34. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves
35. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward
36. Test and Calibrate Gas Analyzers

D. ORGANIZE WORK ROUTINES

1. Organize Documents and Drawings Required on the Job
2. Determine Proper Tools/Equipment/Materials to Perform the Job

3. Coordinate Work Activities with Other Crafts/Units
4. Coordinate Preventive Maintenance Schedule with Planning Group
5. Verify Equipment Isolation Prior to Performance of Work for Safety Reasons
6. Report Abnormal Equipment Problems to Supervisor
7. Write New Calibration Procedures if Needed
8. Follow Specifications
9. Perform Basic Algebraic Operations
10. Perform Basic Trigonometric Functions
11. Perform Basic Calculus Operations

E. COLLECT AND FILE DATA

1. Record Test/Calibration Data
2. Record Preventive Maintenance Data
3. Record Equipment Disconnect Data
4. Evaluate Collected Data
5. Review & Revise Procedures if Needed
6. Write Reports Required by Company
7. Specify Equipment for Control Systems
8. Prepare and Update Specification Forms
9. Write Work Orders
10. Prepare and Update Ladder And/Or Logic Diagrams
11. Program PLC's

F. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES

1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams
3. Study Technical Equipment Information
4. Application of ISA/JIC Standards
5. Understand Proper Use of Test Equipment and Tools
6. Learn to Write Technical Reports
7. Acquire Safe Practices for Handling Hydraulic and Special Tools
8. Utilize Technical Manuals
9. Understand Personal Computers
10. Attend On-Going Safety Training Courses
11. Participate in Plant Related Training
12. Attend PLC Training
13. Attend DCS Training

G. MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES

1. Learn to Review and Forecast Spare Parts Inventory
2. Prepare Parts Request
3. Verify Parts Received
4. Research/Verify Substitute Specifications

H. TROUBLESHOOT, INSTALL, MAINTAIN AND OPERATE MOTOR CONTROL SYSTEMS

1. Troubleshoot, Install, Maintain, and Operate Motor Starters
2. Troubleshoot, Install, Maintain, and Operate Relays
3. Troubleshoot, Install, Maintain, and Operate Pushbuttons
4. Troubleshoot, Install, Maintain, and Operate Switches
5. Troubleshoot, Install, Maintain, and Operate PLC Systems, i.e., PLC and DCS Networks

THE MAST PILOT PROGRAM CURRICULUM AND COURSE DESCRIPTIONS

After completing the Competency Profile and Technical Workplace Competency Outline for each occupational specialty area, each MAST partner reviewed their existing curricula against the industry-verified skill standards in order to identify a suitable foundation for new pilot training programs. Because each college had to comply with the requirements of its respective college system and appropriate state agency, the resulting pilot curricula for occupational specialty areas tended to vary in format and academic requirements (e.g., some programs were based on the semester system, others on the quarter system). Despite differences in the curricula developed at the partner colleges, each of the pilot programs was designed to achieve the following two goals mandated in the MAST grant proposal:

- Pilot Program: "Conduct a one year pilot program with 25 or more selected applicants at each college or advanced technology center to evaluate laboratory content and effectiveness, as measured by demonstrated competencies and indicators of each program area."

- Student Assessment: "Identify global skills competencies of program applicants both at point of entrance and point of exit for entry level and already-employed technicians."

(Note: All occupational specialty areas were not pilot tested at all Development Centers; however, all partner colleges conducted one or more pilot programs.)

Included on the following pages is the curriculum listing for the pilot program which was used to validate course syllabi for this occupational specialty area. This curriculum listing included course names and numbers from the college which conducted the pilot program. The curriculum also shows the number of hours assigned to each of the courses (lecture, lab and credit hours). Also included is a description of each of the courses.

ELECTROMECHANICAL ENGINEERING TECHNOLOGY
INSTRUMENTATION OPTION

		LEC	LAB	CR
FIRST QUARTER				
MAT 191	College Algebra	5	0	5
ENG 191	Composition and Rhetoric I	5	0	5
CIS 191	Computer Programming Fundamentals	3	6	5
DDF 191	Engineering Graphics I	1	6	3
		14	12	18
SECOND QUARTER				
MAT 193	College Trigonometry	5	0	5
ENG 195	Technical Communications	5	0	5
PHY 191	Mechanics	4	3	5
EET 101	DC Circuit Analysis	4	3	5
		18	6	20
THIRD QUARTER				
MAT 195	Differential Calculus	5	0	5
PHY 192	Electricity and Magnetism	4	3	5
EET 102	AC Circuit Analysis I	4	3	5
EET 105	Electronic Devices	4	3	5
		17	9	20
FOURTH QUARTER				
PHY 291	Fluids, Heat, Sound and Light	4	3	5
EET 103	AC Circuit Analysis II	4	3	5
EET 201	Digital Fundamentals	4	3	5
EMT 201	Electromechanical Devices	4	3	5
		16	12	20
FIFTH QUARTER				
EMT 202	Control Systems	4	3	5
EET 203	Microcomputer Fundamentals	4	3	5
EMT 203	Programmable Controllers	3	3	4
EMT 253	Motor Controls	4	3	5
		15	12	19
SIXTH QUARTER				
EMT 254	Introduction to Process Control (Technical Elective)	2	6	4
EMT 250	Control Systems II (Technical Elective)	4	3	5
EMT 251	Distributed Control Systems (Technical Elective)	3	3	4
PSY 191	Introductory Psychology (Social Science Elective)	5	0	5
		14	12	18
	Program Totals	94	63	115

ELECTROMECHANICAL ENGINEERING TECHNOLOGY
INSTRUMENTATION OPTION
COURSE DESCRIPTIONS

CIS 191 **Computer Programming Fundamentals** (3-6-5) Emphasizes fundamental concepts of problem solving using computers. Students explore flow charting, control structures, subroutines, arrays, strings manipulation, matrices, and files. A high level source language is used. The laboratory portion of the course is designed to acquaint students with computer facilities and software utilities. Topics include: system fundamentals, concepts of structured programming, arrays, functions and subroutines, data files, engineering applications, graphics, matrices, and program editing. Laboratory work parallels class work.

DDF 191 **Engineering Graphics I** (1-6-3) Introduces engineering drawing. Topics include: sketching, drafting fundamentals such as use of instruments, linework, lettering, layout, and geometric construction; orthographic projection; pictorial drawing; schematic drawing; descriptive geometry; computer graphics concepts; and engineering drawing conventions. Laboratory work parallels class work.

PHY 191 **Mechanics** (4-3-5) Introduces the classical theories of mechanics. Topics include: measurements and systems of units; Newton's laws; work, energy, and power; impulse and momentum; linear motion and two-dimensional motion; equilibrium; and elasticity. Laboratory exercises supplement class work. Computer use is an integral part of class and laboratory assignments. Prerequisites: MAT 191, College Algebra, and CIS 191, Computer Programming Fundamentals

EET 101 **DC Circuit Analysis** (4-3-5) Emphasizes the knowledge and ability to analyze basic DC circuits, Topics include: units, basic electrical laws, series and parallel circuits, capacitance, an introduction to network analysis and network theorems concepts, and DC instruments. Laboratory work parallels class work. Prerequisites: CIS 191, Computer Programming Fundamentals, and MAT 191, College Algebra

PHY 192 **Electricity and Magnetism** (4-3-5) Introduces theories of electricity and magnetism. Topics include: electrostatic forces and fields, magnetism, circuit elements and theory, electromagnetic waves, and modern physics. Laboratory exercises supplement class work. Computer use is an integral part of class and laboratory assignments. Prerequisites: MAT 193, College Trigonometry, and PHY 191, Mechanics.

EET 102 **AC Circuit Analysis I** (4-3-5) Emphasizes the knowledge and ability to analyze basic AC circuits. Topics include: magnetism, inductance/capacitance, alternating current, AC network theorems, admittance, impedance, phasors, complex power, and applications and use of appropriate instruments. Laboratory work parallels class work. Prerequisites: EET 101, DC Circuit Analysis, and MAT 193, College Trigonometry)

EET 105 **Electronic Devices** (4-3-5) Introduces the conduction process in semi-conductor materials. Topics include: semi-conductor physics; diodes; biasing, stability, and graphical analysis of bipolar junction transistors and field effect transistors; introduction to silicon controlled rectifiers; device curve characteristics; and related devices with selected applications. Laboratory work parallels class work. Prerequisites: EET 101, DC Circuit Analysis, ENG 191, Composition and Rhetoric, and MAT 193, College Trigonometry.

PHY 291 **Fluids, Heat, Sound, and Light** (4-3-5) Introduces classical theories of fluids, heat, sound, and light. Topics include: statics and dynamics of fluids, gas laws, heat transfer, thermodynamics, simple harmonic motion, wave motion, sound, and properties of light. Laboratory exercises supplement class work. Computer use is an integral part of class and laboratory assignments. Prerequisites: MAT 193, College Trigonometry, and PHY 191, Mechanics.

EET 103 **AC Circuit Analysis II** (4-3-5) Continues the study of AC circuit analysis with emphasis on transient analysis and network theorems. Topics include: analysis of complex networks, resonance, transformers, multiple sources, three-phase systems, an introduction to filters and bode plots, and non-sinusoidal waveforms. Laboratory work parallels class work. Prerequisites: EET 102, AC Circuit Analysis, and MAT 195, Differential Calculus.

EET 201 **Digital Fundamentals** (4-3-5) Introduces digital electronics. Topics include: fundamentals of digital techniques; integrated logic circuits involving number systems, logic symbols and gates, Boolean algebra, and optimization techniques; flip-flops and registers; combinational and sequential logic circuits; and memory circuits. Laboratory work parallels class work. Prerequisite: EET 102, AC Circuit Analysis I.

EMT 201 **Electromechanical Devices** (4-3-5) Introduces electromechanical devices which are essential control elements in electrical systems. Topics include: fundamentals of electromechanical devices, control elements in electrical circuits, typical devices such as generators and alternators, DC and AC motors and power factors, and efficiencies in DC, single-phase and three-phase dynamos are stressed. Laboratory work parallels class work. Prerequisite: EET 102, AC Circuit Analysis I.

EMT 202 **Control Systems** (4-3-5) Introduces control systems components and theory as they relate to controlling industrial processes. Mechanical, fluids, temperatures, and miscellaneous sensors are studied with emphasis on measuring techniques. Topics include: open- and closed-loop control theory, feedback, transducers, signal conditioning, and control hardware and actuators. Laboratory work parallels class work. Prerequisite: EET 201, Digital Fundamentals.

EET 203 **Microcomputer Fundamentals** (4-3-5) Continues the study of digital electronics. Topics include: computer arithmetic, analog to digital and digital to analog conversion, microcomputer architecture, and machine level and assembly level language programming. Laboratory work parallels class work. Prerequisites: EET 105, Electronic Devices, and EET 201, Digital Fundamentals.

EMT 203 **Programmable Controllers** (3-3-4) Emphasizes an in-depth study of the programmable controller with programming applications involving controlling industrial processes. Topics include: input and output modules, logic units, memory units, power supplies, ladder diagrams, relay logic timers and counters, control strategy, programming and troubleshooting. Networking is introduced and communications protocol is investigated. Lab work parallels class work. Prerequisites: EET 201, Digital Fundamentals; Corequisite: EMT 201, Electromechanical Devices.

EMT 250 **Control Systems II** (4-3-5) Emphasizes skills in the area of electronic instrumentation and stresses the use of electronic techniques to control industrial processes. Topics include: control systems, control system design, control system construction, and control system test report of failure analysis. Prerequisite: EMT 202, Control Systems.

EMT 251 **Distributed Control Systems** (3-3-4) Continues the study of the various applications of distributed control. This course in intended primarily as a survey source of distributed control verses an in-depth study of any single distributed control system. Topics include: historical perspective and systems, basic system wide orientation, sub systems overview, and report generation. Prerequisite: EMT 202, Control Systems.

EMT 253 **Motor Controls** (4-3-5) Emphasizes the principles of motor controls from fractional horsepower to large magnetic starters, including starting polyphase induction, synchronous, wound rotor, and direct current motors. Topics include: control pilot devices, control circuits and AC reduces voltage starters, three-phase induction wound rotor and synchronous motor controls, DC motors, and solid state motor controls. Prerequisite: EMT 201, Electromechanical Devices.

EMT 254 **Introduction to Process Control** (2-6-4) Emphasizes the knowledge and skills required to draw and interpret standard ISA drawings. Topics include: instrumentation symbols, loop identification, open-loop control, closed-loop control, single-loop control and multi-loop control. Prerequisite: DDF 191, Engineering Graphics I; Corequisite: PHY 291, Fluids, Heat, Sound, and Light.

ELECTROMECHANICAL ENGINEERING TECHNOLOGY
INSTRUMENTATION OPTION
SUPPORT COURSES

MAT 191 **College Algebra** (3-0-5) Emphasizes techniques of problem solving using algebraic concepts. Topics include: algebraic concepts and operations, linear and quadratic equations and functions, simultaneous equations, inequalities, exponents and powers, graphing techniques, and analytic geometry. Prerequisite: Placement by diagnostic testing.

ENG 191 **Composition and Rhetoric I** (5-0-5) Explores the analysis of literature and articles about issues in the humanities and in society. Students practice various modes of writing, ranging from exposition to argumentation and persuasion. The course includes a review of standard grammatical and stylistic usage in proofreading and editing. An introduction to library resources lays the foundation for research. Topics include writing analysis and practice, revision, and research.

MAT 193 **College Trigonometry)** (5-0-5) Emphasizes techniques of problem solving using trigonometric concepts. Topics include: trigonometric functions, properties of trigonometric functions, vectors and triangles, inverse of trigonometric functions/graphic, logarithmic and exponential functions, and complex numbers. Prerequisite: MAT 191, College Algebra

ENG 195 **Technical Communications** (5-0-5) Emphasizes practical knowledge of technical communications techniques, procedures, and reporting formats used in industry and business. Topics include: research, device and process description, formal technical report writing, business correspondence, and oral technical report presentation. Prerequisite: ENG 191, Composition and Rhetoric, with "C" or better.

MAT 195 **Differential Calculus** (5-0-5) Emphasizes the use of differential calculus. Applications of techniques include extreme value problems, motion, graphing, and other topics as time allows. Topics include: derivatives and applications, differentiation of transcendential functions, and an introduction to integration and applications. Prerequisite: MAT 193, College Trigonometry

PSY 191 **Introductory Psychology** (5-0-5) Emphasizes the basics of psychology. topics include: science of psychology; social environments; life stages; physiology and behavior; personality; emotions and motives; conflicts, stress and anxiety; abnormal behavior; and perception, learning, and intelligence.

THE MAST TECHNICAL WORKPLACE COMPETENCY/COURSE CROSSWALK

Upon development of appropriate curricula for the pilot programs, each MAST college began to develop individual course outlines for its assigned specialty area. The skill standards identified in the Competency Profile were cross walked against the technical competencies of the courses in the pilot curriculum. The resulting matrix provided a valuable tool for assessing whether current course content was sufficient or needed to be modified to ensure mastery of entry level technical competencies. Exit proficiency levels for each of the technical competencies were further validated through industry wide surveys both in Texas and across the nation.

The Technical Workplace Competency/Course Crosswalk in the following pages presents the match between industry-identified duties and tasks and the pilot curriculum for . Course titles are shown in columns, duties and tasks in rows. The Exit Level Proficiency Scale, an ascending scale with 5 the highest level of proficiency, includes marked boxes indicating whether the task is covered by the instructor during the course; the numbers 1-5 indicate the degree of attention given to the task and the corresponding proficiency expected on the part of the student. The crosswalk is intended to serve as an aide to other instructional designers and faculty in community college programs across the nation.

Included on the following pages is the Technical Workplace Competency/Course Crosswalk for the pilot program curriculum. This crosswalk validates the fact that the duties and tasks which were identified by industry as being necessary for entry level employees have been incorporated into the development of the course syllabi.

Technical Workplace Competencies/Course

CROSSWALK

TECHNICAL COMPETENCY
INSTRUMENTATION AND CONTROL TECHNICIAN

	Computer Prog. Fundamentals	Engineering Graphics I	Mechanics	DC Circuit Analysis	Electricity and Magnetism	AC Circuit Analysis I	Electronic Devices	Fluids, Heat, Sound and Light	AC Circuit Analysis II	Digital Fundamentals	Electromechanical Devices	Control Systems	Microcomputer Fundamentals	Programmable Controllers	Motor Controls	Introduction to Process Control	Control Systems II	Distributed Control Systems			EXIT PROFICIENCY LEVEL
A. PRACTICE SAFETY																					
A-1 Follow Safety Manuals and All Safety Regulations/Requirements	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
A-2 Use Protective Equipment			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
A-3 Follow Safe Operating Procedures for Hand and Power Tools			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
A-4 Maintain a Clean and Safe Work Environment			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
B. MAINTAIN CONTROL SYSTEMS																					
B-1 Proper Storage of Circuit Boards	X			X	X	X	X		X	X	X		X	X	X	X	X				2
B-2 Collect and Record Data According to Company Requirements		X		X	X		X	X	X	X	X		X	X	X	X	X				4
B-3 Test and Calibrate Transducers According to Specs				X	X	X	X		X	X	X		X	X	X	X	X				4
B-4 Perform Preventive Maintenance Procedures for Control Devices			X	X		X	X	X	X	X	X		X	X	X	X	X				4
B-5 Test and/or Replace Printed Circuit Boards				X		X	X	X	X	X	X		X	X	X	X	X				4
B-6 Function Check Individual Elements Within Loop				X		X	X	X	X	X	X		X	X	X	X	X				4
B-7 Troubleshoot Different Types of System Modules				X		X	X	X	X	X	X		X	X	X	X	X				4
B-8 Test Different Types of Systems Modules				X	X	X	X	X	X	X	X		X	X	X	X	X				4
B-9 Configure Software	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X				2
B-10 Repair Different Types of System Modules				X			X			X	X		X	X	X	X	X				4
B-11 Install Control System Hardware			X			X	X			X	X		X	X	X	X	X				4
B-12 Simulate Control System Check				X	X	X	X			X	X		X	X	X	X	X				4
B-13 Loop-Check Control System		X			X		X			X	X		X	X	X	X	X				4
B-14 Perform On-Line Testing	X			X	X	X	X			X	X		X	X	X	X	X				4
B-15 Troubleshoot and Maintain PLCs and Motor Control Systems				X			X			X	X		X	X	X	X	X				4
C. MAINTAIN FIELD INSTRUMENTATION DEVICES																					
C-1 Test and Calibrate Pressure, Level, Flow, Temperature Switches				X		X			X	X		X	X	X	X	X					4
C-2 Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches				X		X			X	X		X	X	X	X	X					4
C-3 Adjust Dampers and Positioners				X					X	X		X	X	X	X	X					4
C-4 Troubleshoot and Adjust Control Drive (Damper)				X					X	X		X	X	X	X	X					4
C-5 Test and Calibrate Indicators and Gauges				X		X			X	X		X	X	X	X	X					4
C-6 Troubleshoot and Repair Indicators				X		X			X	X		X	X	X	X	X					4
C-7 Test and Calibrate Transmitters				X		X			X	X		X	X	X	X	X					4
C-8 Test and Calibrate Recorders				X					X	X		X	X	X	X	X					4

Technical Workplace Competencies/Course

CROSSWALK

TECHNICAL COMPETENCY
INSTRUMENTATION AND CONTROL TECHNICIAN

	Computer Prog. Fundamentals	Engineering Graphics I	Mechanics	DC Circuit Analysis	Electricity and Magnetism	AC Circuit Analysis I	Electronic Devices	Fluids, Heat, Sound and Light	AC Circuit Analysis II	Digital Fundamentals	Electromechanical Devices	Control Systems	Microcomputer Fundamentals	Programmable Controllers	Motor Controls	Introduction to Process Control	Control Systems II	Distributed Control Systems		EXIT PROFICIENCY LEVEL
C-9 Troubleshoot and Repair Recorders					X						X	X		X	X	X	X	X		4
C-10 Troubleshoot Linear Variable Differential Transformers					X						X	X		X	X	X	X	X		3
C-11 Troubleshoot, Repair and Calibrate Transmitters					X						X	X		X	X	X	X	X		4
C-12 Test Different Field Sensing Elements					X		X				X	X		X	X	X	X	X		4
C-13 Install/Replace Field Sensing Elements			X		X						X	X		X	X	X	X	X		4
C-14 Troubleshoot and Repair Transmitters					X						X	X		X	X	X	X	X		4
C-15 Tune Controllers: Pneumatic and Electronic					X						X	X		X	X	X	X	X		4
C-16 Troubleshoot and Repair Plant Computing Systems Relating to Process Controls					X						X	X		X	X	X	X	X		4
C-17 Troubleshoot and Repair Solenoid Valves					X						X	X		X	X	X	X	X		4
C-18 Perform Preventive Maintenance Procedures to Field Devices					X						X	X		X	X	X	X	X		4
C-19 Test and Repair Thermocouples					X						X	X		X	X	X	X	X		3
C-20 Check and Test Vibration Sensing Elements					X						X	X		X	X	X	X	X		4
C-21 Inspect and Troubleshoot Power Supplies and Converters					X						X	X		X	X	X	X	X		3
C-22 Test and Calibrate Control Valve Actuators					X			X			X	X		X	X	X	X	X		4
C-23 Troubleshoot and Repair Control Valves/Positioners					X						X	X		X	X	X	X	X		4
C-24 Test and Calibrate Controllers					X						X	X		X	X	X	X	X		4
C-25 Troubleshoot and Repair Local Controllers											X	X		X	X		X	X		4
C-26 Troubleshoot and Repair Electronic Computing Relays											X	X		X	X	X	X	X		4
C-27 Troubleshoot and Repair Analyzers									X		X	X		X	X	X	X	X		3
C-28 Test and Calibrate Air Analyzers									X		X	X		X	X	X	X	X		4
C-29 Test and Calibrate Water Analysis									X		X	X		X	X	X	X	X		4
C-30 Troubleshoot Servo Valves									X		X	X		X	X	X	X	X		4
C-31 Calibrate Servo Valves									X		X	X		X	X	X	X	X		4
C-32 Test and Clean Video Display Unit									X		X	X		X	X	X	X	X		4
C-33 Check and Adjust Video Display Unit					X			X	X		X	X		X	X	X	X	X		2
C-34 Specify and Configure Smart Field Devices, i.e., Transmitters and Valves					X			X	X		X	X		X	X	X	X	X		3
C-35 Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward									X		X	X		X	X	X	X	X		4
C-36 Test and Calibrate Gas Analyzers									X		X	X		X	X	X	X	X		4
D. ORGANIZE WORK ROUTINES									X		X	X		X	X	X	X	X		4
D-1 Organize Documents and Drawings Required on the Job									X			X	X	X						4

Technical Workplace Competencies/Course

CROSSWALK

TECHNICAL COMPETENCY
INSTRUMENTATION AND CONTROL TECHNICIAN

	Computer Prog. Fundamentals	Engineering Graphics I	Mechanics	DC Circuit Analysis	Electricity and Magnetism	AC Circuit Analysis I	Electronic Devices	Fluids, Heat, Sound and Light	AC Circuit Analysis II	Digital Fundamentals	Electromechanical Devices	Control Systems	Microcomputer Fundamentals	Programmable Controllers	Motor Controls	Introduction to Process Control	Control Systems II	Distributed Control Systems			EXIT PROFICIENCY LEVEL
D-2 Determine Proper Tools/Equipment/Materials to Perform the Job					X			X			X	X				X	X	X			4
D-3 Coordinate Work Activities With Other Crafts/Units					X						X	X				X	X	X			4
D-4 Coordinate Preventive Maintenance Schedule with Planning Group					X							X				X	X	X			2
D-5 Verify Equipment Isolation Prior to Performance of Work for Safety Reasons					X			X				X				X	X	X			4
D-6 Report Abnormal Equipment Problems to Supervisor					X							X				X	X	X			2
D-7 Write New Calibration Procedures if Needed					X							X				X	X	X			1
D-8 Follow Specifications					X							X				X	X	X			4
D-9 Perform Basic Algebraic Operations					X							X				X	X	X			3
D-10 Perform Basic Trigonometric Functions					X							X				X	X	X			3
D-11 Perform Basic Calculus Operations					X							X				X	X	X			3
E. COLLECT AND FILE DATA																					
E-1 Record Test/Calibration Data					X			X								X	X	X			4
E-2 Record Preventative Maintenance Data					X											X	X	X			3
E-3 Record Equipment Disconnect Data					X											X	X	X			4
E-4 Evaluate Collected Data					X			X								X	X	X			2
E-5 Review and Revise Procedures if Needed					X											X	X	X			2
E-6 Write Reports Required by Company					X											X	X	X			4
E-7 Specify Equipment for Control Systems					X											X	X	X			2
E-8 Prepare and Update Specification Forms					X											X		X			2
E-9 Write Work Orders																X		X			2
E-10 Prepare and Update Ladder and/or Logic Diagrams					X									X				X			4
E-11 Program PLCs														X				X			4
F. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES																					
F-1 Read/Interpret Diagrams and Drawings					X						X	X		X	X	X	X	X			4
F-2 Sketch Diagrams					X						X	X		X	X	X	X	X			3
F-3 Study Technical Equipment Information					X						X	X		X	X	X	X	X			4
F-4 Application of ISA/JIC Standards					X						X	X		X	X	X	X	X			4
F-5 Understand Proper Use of Test Equipment and Tools					X						X	X		X	X	X	X	X			4
F-6 Learn to Write Technical Reports					X						X	X		X	X	X	X	X			3
F-7 Acquire Safe Practices for Handling Hydraulic and Special Tools					X						X	X		X	X	X	X	X			4

Technical Workplace Comptencies/Course

CROSSWALK

TECHNICAL COMPETENCY
INSTRUMENTATION AND CONTROL TECHNICIAN

	Computer Prog. Fundamentals	Engineering Graphics I	Mechanics	DC Circuit Analysis	Electricity and Magnetism	AC Circuit Analysis I	Electronic Devices	Fluids, Heat, Sound and Light	AC Circuit Analysis II	Digital Fundamentals	Electromechanical Devices	Control Systems	Microcomputer Fundamentals	Programmable Controllers	Motor Controls	Introduction to Process Control	Control Systems II	Distributed Control Systems			EXIT PROFICIENCY LEVEL
F-8 Utilize Technical Manuals					X						X	X		X	X	X	X	X			4
F-9 Understand Personal Computers	X				X						X	X	X	X	X	X	X	X			4
F-10 Attend On-Going Safety Training Courses					X						X	X		X	X	X	X	X			4
F-11 Participate in Plant Related Training					X						X	X		X	X	X	X	X			4
F-12 Attend PLC Training														X		X		X			4
F-13 Attend DCS Training																X		X			4
G. MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES																					
G-1 Learn to Review and Forecast Spare Parts Inventory					X						X	X		X	X	X	X	X			3
G-2 Learn Parts Requests					X						X	X		X	X	X	X	X			3
G-3 Verify Parts Received					X						X	X		X	X	X	X	X			3
G-4 Research/Verify Substitute Specifications					X						X	X		X	X	X	X	X			2
H. TROUBLESHOOT, INSTALL, MAINTAIN AND OPERATE MOTOR CONTROL SYSTEMS																					
H-1 Troubleshoot, Install, Maintain, and Operate Motor Systems					X						X	X		X	X	X	X	X			4
H-2 Troubleshoot, Install, Maintain, and Operate Relays					X						X	X		X	X	X	X	X			4
H-3 Troubleshoot, Install, Maintain, and Operate Pushbuttons					X						X	X		X	X	X	X	X			4
H-4 Troubleshoot, Install, Maintain, and Operate Switches					X						X	X		X	X	X	X	X			4
H-5 Troubleshoot, Install, Maintain, and Operate PLC Systems, i.e., PLC and DCS Networks					X						X	X		X	X	X	X	X			4

INSTRUMENTATION AND CONTROL TECHNICIAN
TECHNICAL WORKPLACE COMPETENCIES
EXIT LEVEL PROFICIENCY MATRIX

Instrumentation and Control Technician:

will be able to troubleshoot, repair, calibrate, specify and commission as required all instrumentation and control components relating to overall plant operations. This is to include dynamic evaluation, testing, controller tuning, and total system performance evaluations.

The following matrix identifies the five exit levels of technical workplace competencies for the Instrumentation and Control Technician Certificate at Augusta Technical Institute in Augusta, Georgia.

EXIT LEVEL OF PROFICIENCY					
Technical Workplace Competency	**1**	**2**	**3**	**4**	**5**
	rarely	routinely with supervision	routinely with limited supervision	routinely without supervision	initiates/ improves/ modifies and supervises others

THE MAST SCANS/COURSE CROSSWALK

The Secretary's Commission on Achieving Necessary Skills (SCANS), U. S. Department of Labor, has identified in its "AMERICA 2000 REPORT' the following five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance:

COMPETENCIES:

Resources:	Identifies, organizes, plans, and allocates resources
Interpersonal:	Works with others
Information:	Acquires and uses information
Systems:	Understands complex inter-relationships
Technology:	Works with a variety of technologies

FOUNDATION SKILLS:

Basic Skills:	Reads, writes, performs arithmetic and mathematical operations, listens and speaks
Thinking Skills:	Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons
Personal Qualities:	Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty

Recognizing the value of SCANS proficiencies to job performance, as well as the growing mandate in many states to include SCANS activities in course curricula, MAST asked survey respondents to review the SCANS skill sets in the context of the draft skill standards for each occupational specialty area. MAST also incorporated evaluation of SCANS competencies and foundation skills into its assessment of the pilot training curricula. The results were summarized in a crosswalk that allowed MAST staff to modify course content where needed to strengthen achievement of SCANS competencies.

The following pages present the SCANS/Course Crosswalk for the pilot curriculum in Courses are listed along the top and SCANS competencies and foundations are shown along the left side of the matrix. An exit level proficiency matrix for SCANS competencies and foundation skills is provided as well.

As "soft" skills, the SCANS competencies are inherently difficult to quantify. MAST realizes that some faculty will emphasize the SCANS more or less than others. The SCANS/Course Crosswalk matrix has been included with this course documentation to show the importance of these "soft skills" and the importance of their being addressed in the classroom (particularly in technical classes). In time, faculty will learn to make these types of SCANS activities an integral and important part of the teaching process.

Included on the following pages is the SCANS/Course Crosswalk for the pilot program curriculum. This crosswalk validates the fact that the "soft skills" (SCANS) which were identified by industry as being necessary for entry level employees have been incorporated into the development of the course syllabi. Also included is a matrix which defines the exit level of proficiency scale (1-5).

SCANS/Course

CROSSWALK

NSTRUMENTATION AND CONTROL TECHNICIAN

COMPETENCY	Computer Prog. Fundamentals	Engineering Graphics I	Mechanics	DC Circuit Analysis	Electricity and Magnetism	AC Circuit Analysis I	Electronic Devices	Fluids, Heat, Sound and Light	AC Circuit Analysis II	Digital Fundamentals	Electromechanical Devices	Control Systems	Microcomputer Fundamentals	Programmable Controllers	Motor Controls	Introduction to Process Control	Control Systems II	Distributed Control Systems			EXIT PROFICIENCY LEVEL
(RS) RESOURCES:																					
A. Allocates time	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
B. Allocates money														X		X		X			2
C. Allocates material and facility resources	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
D. Allocates human resources														X		X	X	X			2
(IN) INTERPERSONAL SKILLS:																					
A. Participates as a member of a team	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
B. Teaches others	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
C. Serves clients/customers	X													X		X		X			2
D. Exercises leadership																X		X			1
E. Works with cultural diversity	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
(IF) INFORMATION SKILLS:																					
A. Acquires and evaluates information	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
B. Organizes and maintains information	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
C. Interprets and communicates information	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
D. Uses computers to process information	X	X											X	X		X		X			2
(SY) SYSTEMS:																					
A. Understands systems	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
B. Monitors and corrects performance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
C. Improves and designs systems	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			2
(TE) TECHNOLOGY:																					
A. Selects technology	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
B. Applies technology to task	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
C. Maintains and troubleshoots technology	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4

SCANS/Course

CROSSWALK

NSTRUMENTATION AND CONTROL TECHNICIAN

FOUNDATION SKILLS	Computer Prog. Fundamentals	Engineering Graphics I	Mechanics	DC Circuit Analysis	Electricity and Magnetism	AC Circuit Analysis I	Electronic Devices	Fluids, Heat, Sound and Light	AC Circuit Analysis II	Digital Fundamentals	Electromechanical Devices	Control Systems	Microcomputer Fundamentals	Programmable Controllers	Motor Controls	Introduction to Process Control	Control Systems II	Distributed Control Systems			EXIT PROFICIENCY LEVEL
(BS) BASIC SKILLS:																					
A. Reading	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
B. Writing	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			3
C. Arithmetic and mathematics	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
D. Listening	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			4
E. Speaking																X		X			3
(TS) THINKING SKILLS:																					
A. Creative thinking															X		X	X	X		2
B. Decision making	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		3
C. Problem solving	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		4
D. Seeing things in the mind's eye	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		3
E. Knowing how to learn	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		2
F. Reasoning	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		3
(PQ) PERSONAL QUALITIES:																					
A. Responsibility															X	X	X	X	X		3
B. Self-esteem	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		3
C. Social																	X		X		2
D. Self-management															X		X	X	X		3
E. Integrity/honesty																	X		X		3

SCANS
COMPETENCIES AND FOUNDATION SKILLS
EXIT LEVEL PROFICIENCY MATRIX

The Secretary's Commission on Achieving Necessary Skills (SCANS), U. S. Department of Labor, has identified in it's "AMERICA 2000 REPORT' the following five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance:

COMPETENCIES:

Resources:	Identifies, organizes, plans, and allocates resources
Interpersonal:	Works with others
Information:	Acquires and uses information
Systems:	Understands complex inter-relationships
Technology:	Works with a variety of technologies

FOUNDATION SKILLS:

Basic Skills:	Reads, writes, performs arithmetic and mathematical operations, listens and speaks
Thinking Skills:	Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons
Personal Qualities:	Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

The following matrix identifies the five exit levels of proficiency that are needed for solid job performance.

EXIT LEVEL OF PROFICIENCY					
SCANS Competencies and Foundation Skills	**1**	**2**	**3**	**4**	**5**
	rarely	routinely with supervision	routinely with limited supervision	routinely without supervision	initiates/ improves/ modifies and supervises others

MAST/01/012296

THE MAST COURSE SYLLABI
"PILOT PROGRAM"

MAST has produced a very unique set of course outlines, driven and validated by industry and encompassing the broad range of technologies covered by the MAST grant. The course outlines also include proposed SCANS activities that will be useful to an instructor in preparing students to enter the workforce of the future.

Included in the following pages are final course outlines developed and refined in the process of piloting the MAST training programs. The outlines include a brief course description; required course materials (e.g., textbook, lab manual, and tools, if available); proposed method of instruction; proposed lecture and lab outlines; and detailed course objectives for both Technical Workplace Competencies and SCANS Competencies.

These outlines were completed and revised during the second year of MAST, following completion of the pilot phase. The outlines are intended to serve as an aide to other instructional designers and faculty in community college programs across the nation.

Included on the following pages are the Course Syllabi for each of the courses which were taught during the pilot program.

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

COLLEGE ALGEBRA

MAST PROGRAM
COURSE SYLLABUS
COLLEGE ALGEBRA

Lecture hours/week: 5 **Lab hours/week: 0** **Credit hours: 5**

COURSE DESCRIPTION:

Emphasizes techniques of problem solving using algebraic concepts. Topics include: algebraic concepts and operations, linear and quadratic equations and functions, simultaneous equations, inequalities, exponents and powers, graphing techniques, and analytic geometry.

PREREQUISITE/COREQUISITE: **Placement by diagnostic testing**

REQUIRED COURSE MATERIALS:

Textbook: Basic Technical Mathematics with Calculus, 6th Ed.

Hand Tools/Quantity Required:

Tools	
Scientific Calculator	1
graph paper	1 pack
pencils	
straight edge	1

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and discussions.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. satisfactorily perform on written, oral, and practical examinations
2. satisfactorily perform on outside assignments including writing assignments
3. contribute to class discussions
4. maintain attendance per current policy

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Numbers	2	5
Fundamental Laws & Operations of Algebra		
Calculators and Approximate Numbers		
Exponents		

Scientific Notation		
Roots and Radicals		
Addition and Subtraction of Algebraic Expressions		
Multiplication of Algebraic Expressions		
Division of Algebraic Expressions		
Solving Equations	35	5
Formulas and Literal Equations		
Applied Verbal Problems		
Properties of Inequalities	75	5
Solving Linear Inequalities		
Introduction of Functions		
More About Functions		
Rectangular Coordinates	84	5
The Graph of a Function		
The Graphing Calculator		
Graphs of Functions by Tables of Data		
Linear Equations	128	5
Graphs of Linear Equations Basic Definitions		
The Straight Line		
The Ellipse		
Solving Systems of Two Linear Equations in Two Unknowns Graphically	135	5
Solving Systems of Two Linear Equations in Two Unknowns Algebraically		
Solving Systems of Two Linear Equations in Two Unknowns by Determinants		
Solving Systems of Three Linear Equations in Three Unknowns Algebraically		
Solving Systems of Three Linear Equations in Three Unknowns by Determinants		
Graphical Solution of Inequalities with Two Variables	462	5
Special Products		
Factoring: Common Factor and Difference of Squares		
Factoring Trinomials	172	5
The Sum and Difference of Cubes		
Equivalent Fractions		
Multiplication and Division of Fractions		
Addition and Subtraction of Fractions		
Equations Involving Fractions	191	5

Quadratic Equations: Solution by Factoring		
Completing the Square		
The Quadratic Formula		
The Graph of the Quadratic Function		
The Circle	547	5
The Ellipse		
The Hyperbola		
Review		
Final Exam		
	Total Lecture Hours	**50**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. ORGANIZE WORK ROUTINES

1. Organize Documents and Drawings Required on the Job
2. Determine Proper Tools/Equipment/Materials to Perform the Job
3. Perform Basic Algebraic Operations

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*
   1. read and interpret blueprints
   2. organize and apply theories of machine tool operation
   3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*
   1. demonstrate knowledge of the following systems:
      a. laboratory organization structure: physical and social
      b. organization of personnel and facilities on the shop floor
      c. systematic approach to the mechanical process
      d. dimensioning and measurement systems
      e. systematic organization of training materials
   2. monitors and corrects performance during
      a. the practical process
      b. adjustments of individual laboratory work schedule
      c. constantly evaluating the quality of work to achieve acceptable standards
      d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*
   1. chooses procedure, tools and equipment required to perform the task
   2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
   3. maintains and troubleshoots equipment
      a. applies appropriate preventative maintenance
      b. when operating machines
      c. reports all malfunctions of equipment to supervisor/instructor
      d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*
   1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
      a. studies student laboratory manual
      b. interprets blueprints and technical drawings
      c. read/studies textbook
      d. follow a daily laboratory schedule to maintain appropriate time-line and task completion
   2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
      a. outline the steps necessary to perform a mechanical task
      b. maintain a lecture notebook
      c. submit written responses to chapter question assignments
      d. complete all written assignments
   3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*

a. keeps a running computation of individual grade
b. performs mathematical computations necessary to understand course

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist

c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

COMPOSITION AND RHETORIC I

MAST PROGRAM
COURSE SYLLABUS
COMPOSITION AND RHETORIC I

Lecture hours/week: 5 **Lab hours/week: 0** **Credit hours: 5**

COURSE DESCRIPTION:

Emphasizes the development and improvement of written and oral communications abilities. Topics include: idea development; vocabulary; spelling; out-lining; sentence elements; revision; unity and coherence in basic paragraph development; re-search; exploration of communication modes including description, exposition, argumentation, and persuasion; and functional writing as applied to reports, abstracts, and technical papers.

PREREQUISITE: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: From Idea to Essay

COURSE OBJECTIVES:
Students who have successfully completed this course will be able to:

1. Demonstrate through use a knowledge of grammatical structure, as well as punctuation and other mechanics.
2. Demonstrate the ability to write clear, coherent, well-organized paragraphs.
3. Recognize correct spelling in one's own or other's writing.
4. Present oral summaries outside reading.
5. Write descriptions drawing details from observation.
6. Write clear, coherent, well-organized explanations.
7. Demonstrate through writing the ability to successfully employ the various methods of development (including comparison and contrast, cause division, illustration, definition, classification, and division, argumentation, process). And to choose the appropriate form.
8. Articulate clean oral response to reading.
9. Identify the major steps in conducting research.
10. Locate and use appropriate reference materials for written and oral reports.

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. satisfactorily perform on written, oral, and practical examinations

2. satisfactorily perform on outside assignments including writing assignments
3. contribute to class discussions
4. maintain attendance per current policy

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Fundamentals of Grammar and Composition		**15**
Sentence elements		
Review of basic parts of speech		
Complete sentence paragraph, placement of modifiers, phrases, and clauses		
Paragraph construction		
Topic sentence		
Development		
Unity and coherence		
Transitional devices		
Spelling		
Fundamentals of Oral Communications		**8**
Presentation		
Mode of Written and Oral Communications		**15**
Description		
Exposition		
Argumentation and persuasion		
Oral communication		
Research		**12**
Steps		
References		
	Total Lecture Hours	**50**

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*

1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*

   a. studies student laboratory manual
   b. interprets blueprints and technical drawings

c. read/studies textbook
d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments
3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course
4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
    a. demonstrate mastery of the basic skills and techniques
    b. use these sequential skills to support mastery of new skills
    c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
    a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
    b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
    c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*
1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
    a. develops an understanding that in order to be successful you must be a "good" student
    b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
    c. develops an understanding good students know what they are going to do in class and does not waste time
    d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
    a. learns to take pride in his or her work through positive reinforcement
    b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
    c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
    a. assist classmates in improving technical skills
    b. assist students with special needs as a peer mentor
    c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
    a. maintain a record of academic achievement (individual grade book)
    c. make accommodations to laboratory schedules due to broken equipment/tools
    d. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*

a. accept the responsibility for own actions
b. exhibit personal honesty at all times
c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Staircase to Writing and Reading, Costy, A., & Tighe, D. J. (Latest Edition), Englewood Cliffs, NJ: Prentice-Hall
2. Harbrace College Handbook, Hodges, R. S., & Whitten, M. E. (1982), New York: Harcourt Brace Jovanovich
3. Patterns for College Writing, Kirsner, L. G. & Mandel, S. R. (1986) (3rd Ed.), New York: St. Martin's Press
4. Readings for Writers, McCuen, J. R., & Winkler, A. C. (1986), New York: Harcourt Brace Jovanovich
5. Rhetoric Made Plain, Winkler, A. C., & McCuen, J. R. (1984), New York: Harcourt Brace Jovanovich.

***M**achine Tool **A**dvanced **S**kills*
***T**echnology Program*

MAST

COURSE SYLLABUS

COMPUTER PROGRAMMING FUNDAMENTALS

MAST PROGRAM
COURSE SYLLABUS
COMPUTER PROGRAMMING FUNDAMENTALS

Lecture hours/week: 3 **Lab hours/week: 6** **Credit hours: 5**

COURSE DESCRIPTION:

Emphasizes fundamentals concepts of problems solving using computers. Students explore flow charting control structures, subroutines, arrays, strings manipulation, matrices, and files. A high level source language is used. The laboratory portion of the course is designed to acquaint students with computer facilities and software utilities. Topics include: DOS instructions , word processing (WordPerfect), spreadsheet applications (Lotus), systems fundamentals, concepts of structured programming, functions and subroutines, engineering applications, graphics, and program editing. Laboratory work parallels class work.

PREREQUISITE: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: Computer Currents by George Beekman

Supplies:

Flowchart template
Coding forms
In addition it is the responsibility of each student to bring his/her own coding papers, pencil, pen and notebook to class each day.

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy

7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
DOS Overview		
QBASIC Overview		
QBASIC Environment		
Test 1		
Structured QBASIC Programs		
Structured Programs (continued)		
Test 2		
Midterm		
Arithmetic Expressions and Output		
Interactive Processes and Decisions		
Working with Words		
Calculation, Visualization, Simulation		
Final Exam		
Total Lecture Hours		**30**

LAB OUTLINE:

Lab Topic	Contact Hrs.
DOS Overview	
QBASIC Overview	
QBASIC Environment	
Structured QBASIC Programs	
Arithmetic Expressions and Output	
Interactive Processes and Decisions	
Working with Words	
Calculation, Visualization, Simulation	
Total Lab Hours	**60**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices

B. MAINTAIN CONTROL SYSTEMS

1. Proper Storage of Circuit Boards
2. Configure Software
3. Perform On-Line Testing

C. ORGANIZE WORK ROUTINES

1. Organize Documents and Drawings Required on the Job
2. Follow Specifications

D. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES

1. Understand Personal Computers

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. Information: Acquires and uses information

1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. Systems: Understands complex inter-relationships

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards

d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly.

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement

b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

ENGINEERING GRAPHICS I

MAST PROGRAM
COURSE SYLLABUS
ENGINEERING GRAPHICS I

Lecture hours/week: 1 **Lab hours/week: 6** **Credit hours: 3**

COURSE DESCRIPTION:

This course introduces engineering drawing using freehand sketching and computer graphics as the necessary engineering graphics tools for the 1990's. The intent of this course is to provide the student with introductory skills necessary to communicate, Freehand sketching, Computer system fundamentals, Computer-Aided Drafting fundamentals (CAD), and an introduction to making working drawings from solid computer models, 2D entity construction, as well as an introduction to graphical vector analysis.

PREREQUISITE: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: The AutoCAD Tutor for Engineering Graphics, Kalameja, Alan J., Delmar Publishers, 1995, ISBN#0-8273-5914-4
Introduction to Engineering Drawing, Luzadder, Warren J.; Second Edition, Prentice Hall, 1993, ISBN#0-13-480849

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all lab rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction	3	1

Design Process and Graphics	11		1
Computer-Aided Design and Drafting	37		1
Freehand Sketching	59		1
Engineering Geometry	73		1
The Theory of Shape Description	95		1
The Theory of Size Description	108		1
Multiviews	127		1
Auxiliary Views	152		1
Sectional Views	163		1
Pictorial Views	174		1
		Total Lecture Hours	**10**

LAB OUTLINE:

Lab Topics	Contact Hrs.
AutoCAD Basics	3
Object Construction and Manipulation	3
Geometric Constructions	3
Shape Description/Multi-View Projection	3
Dimensioning Techniques	6
Analyzing 2-D Drawings	6
Region Modeling Techniques	6
Section Views	6
Auxiliary Views	6
Isometric Drawings	6
3-D Modeling	6
Solid Modeling	6
Total Lab Hours	**60**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment
   c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment

a. Keep work areas clean
b. Clean machine/hand tools when work is completed
c. Put tools away when work is finished
d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Loop-Check Control System

C. MAINTAIN FIELD INSTRUMENTATION DEVICES

1. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward

D. COLLECT AND FILE DATA

1. Prepare and Update Ladder And/Or Logic Diagrams

E. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES

1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. Information: Acquires and uses information

1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. Systems: Understands complex inter-relationships

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social

b. organization of personnel and facilities on the shop floor
c. systematic approach to the mechanical process
d. dimensioning and measurement systems
e. systematic organization of training materials

2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

*E. **Technology:** Works with a variety of technologies*

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

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*A. **Basic Skills:** Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

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   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

*2. **Writing:** Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

*3. **Arithmetic/Mathematics:** Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

*4. **Listening:** Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations

d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
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1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work

c. develops an understanding good students know what they are going to do in class and does not waste time
d. develops a fine work-ethic

2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management

5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

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*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

COLLEGE TRIGONOMETRY

MAST PROGRAM
COURSE SYLLABUS
COLLEGE TRIGONOMETRY

Lecture hours/week: 5 **Lab hours/week: 0** **Credit hours: 5**

COURSE DESCRIPTION:

Emphasizes techniques of problem solving using trigonometric concepts. Topics include: trigonometric functions, properties of trigonometric functions, vectors and triangles, inverse of trigonometric functions/graphic, logarithmic and exponential functions, and complex numbers.

PREREQUISITE: **College Algebra**

REQUIRED COURSE MATERIALS:

Textbook: Basic Technical Mathematics with Calculus, 6th Ed.

Hand Tools/Quantity Required:

Tools	
Scientific Calculator	1
Graph paper	1 pack
Pencils	
Straight edge	1

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and discussions.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. satisfactorily perform on written, oral, and practical examinations
2. satisfactorily perform on outside assignments including writing assignments
3. contribute to class discussions
4. maintain attendance per current policy

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Trigonometric Functions		**20**
Signs of the Trigonometric Functions		
Define the Six Trigonometric Functions		

Determine the Sign of the Function
of an Angle
Radians
Perform Trigonometric Computations
with Angles
Measures in Radians
Properties of Trigonometric Functions **30**
Recognize and Verify the Basic
Trigonometric Identities
Trigonometric Equations (Conditional)
Prove the Validity of Trigonometric
Equations by Means of the
Trigonometric Identities
Positive Integers as Exponents
Perform Algebraic Operations With
Exponents
Expressed as Integers or Fractions
Zero and Negative Exponents
Fractional Exponents

Total Lecture Hours **50**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. ORGANIZE WORK ROUTINES

1. Organize Documents and Drawings Required on the Job
2. Determine Proper Tools/Equipment/Materials to Perform the Job
3. Perform Basic Trigonometric Functions

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

*A. **Resources:** Identifies, organizes, plans, and allocates resources*

1. follows a schedule to complete assigned tasks on time

2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*

1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*

   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook

d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly.

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*
1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management

5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

MAT193
02/081796

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

TECHNICAL COMMUNICATIONS

MAST PROGRAM
COURSE SYLLABUS
TECHNICAL COMMUNICATIONS

Lecture hours/week: 5 **Lab hours/week: 0** **Credit hours: 5**

COURSE DESCRIPTION:

Emphasizes practical knowledge of technical communications techniques, procedures, and reporting formats used in industry and business. Topics include: reference use and research, device and process descriptions, formal technical report writing, business correspondence, and oral technical report presentation.

PREREQUISITE: Composition and Rhetoric I

REQUIRED COURSE MATERIALS:

Textbook: Technical Writing: A Practical Approach, Pfeiffer, W. S., 2nd edition (1994), New York: Merrill

Supplies:

Composition notebook (for students notes)
Loose leaf note paper (for class work submission)
Regulation report cover
Note cards (3x5 and 4x6 or 5x7)
Black or blue pen
Pencil

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, and discussions.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. satisfactorily perform on written and oral examinations
2. satisfactorily perform on outside assignments including writing assignments
3. contribute to class discussions
4. maintain attendance per current policy

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Reference Use and Research	**Chapters 3 and 13**	**5**
Orientation: Process in Technical		

Writing, Technical Research Report: Informal Report, Including Internal Documentation (groups in class) Library Orientation		
Organizing Information Styles in Technical Writing Organizing Information, Styles in Technical Writing Report: Topic Memo Due; Free-Write on Topic (in class)	**Chapters 3 and 15**	**5**
Informal Report Writing Letters and Memos, Informal Reports Report: Problem Memo (groups in class); Purpose Statement and Informal Outline Due (handwritten drafts); Reference List Due (APA format in draft form)	**Chapters 7 and 8**	**5**
Formal Technical Report Writing Formal Reports and Oral Communication Report: Abstract of Journal Article for Formal Report (see text page 437, informational)	**Chapters 9 and 12**	**5**
Patterns of Organization, Process Descriptions and Instructions Report: Description of Mechanisms (groups in class); Note Cards Due	**Chapters 5 (pages 111-120) and 6**	**5**
Page Design, Graphics Report: Purpose Statement Followed by Formal Outline Due (typed); Two Copies Progress Memo Due (one addressed to oral report)	**Chapters 4 and 11**	**5**
Drafting, Editing, and Revising Report: Transmittal Memorandum Due; Rough Draft Due for Final Report		**5**
Business Correspondence The Job Search Report: Final Drafts Due (two copies; one for advisor)	**Chapter 14**	**5**
Oral Technical Report Presentation		**5**

Final Oral Presentations
Report: Resumes (class discussion)
Due Week 10
Review 5
Report: Final Oral Reports; Course
Evaluation; and Final Exam

Total Lecture Hours **50**

COURSE OBJECTIVES: SCANS COMPETENCIES

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The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources
1. follows a schedule to complete assigned tasks on time
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4. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others
1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. Information: Acquires and uses information
1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. Systems: Understands complex inter-relationships
1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
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   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule

c. constantly evaluating the quality of work to achieve acceptable standards
d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

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   c. balances social and academic life/responsibilities
   d. accepts responsibility
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   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
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   d. develops a fine work-ethic
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a. learns to take pride in his or her work through positive reinforcement
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c. share laboratory resources (machines, tools and instructor's individual attention)

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
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a. accept the responsibility for own actions
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d. understand the consequences of unethical behaviors

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

MECHANICS

MAST PROGRAM
COURSE SYLLABUS
MECHANICS

Lecture hours/week: 4 **Lab hours/week: 3** **Credit hours: 5**

COURSE DESCRIPTION:

The first of three courses in the calculus based physics sequence. This course is an introduction to classical mechanics. Topics include: physical quantities, measurements of physical quantities, system of units, vector algebra, kinematics, Newton's Laws, rotational motion, momentum, energy, angular momentum, conservation laws, impulse, mechanical equilibrium and elasticity. Laboratory exercises supplement class work. Computer use is an integral part of the class and laboratory assignments.

PREREQUISITE: **College Algebra and Computer Programming Fundamentals**

REQUIRED COURSE MATERIALS:

Textbook: University Physics, by William P. Crummet and Author B. Western

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Measurements and Systems of Units		6

Scientific Notation
- Express and manipulate numbers in scientific notation

Systems of Units
- Explain SI, CGS, and FPS unit systems
- Change a physical quantity from one set of units to another

Vectors
- Explain the difference between vector and scalar quantities
- Express vector quantities in polar and component form

Newton's Law 7

Newton's Laws of Motion
- State Newton's laws of motion

Newton's Universal Law of Gravitation
- Calculate the gravitational attraction between two bodies

Mass and Weight
- Distinguish between force and mass and define the units of each

Application of Newton's Laws
- Solve dynamics problems involving constant forces

Work, Energy and Power 7

Work, Energy and Power
- Define work, potential energy, kinetic energy and power, and identify the units of each

Conservation of Energy
- State the law of conservation and energy

Work
- Compute the work done by both constant and varying forces
- Use the work-energy theorem in solving problems

Kinetic Energy

- Compute the translational kinetic energy of a body

Hooke's Law
- Solve problems with Hooke's law

Potential Energy
- Compute the elastic potential energy stored in a spring
- Compute the gravitational potential energy of an object

Power
- Compute the power given appropriate parameters

Impulse and Momentum 7

Momentum
- Define the momentum and identify its units

Conservation of Momentum
- State the law of conservation of momentum

Elastic and Inelastic Collisions
- Solve elastic and inelastic collision problems

One and Two-Dimensional Motion 7

Displacement
- Define displacement and identify its units

Velocity and Speed
- Define both velocity and speed and identify their respective units

Acceleration
- Define acceleration and identify its units

Motion and Constant Acceleration
- Solve problems involving uniformly accelerated motion

Angular Displacement
- Define angular displacement, angular velocity

Circular Motion
- Define centripetal force and centripetal acceleration

Solve rotational kinematics problems	
Calculate the centripetal force exerted on a body the associated centripetal acceleration	
Mechanical Equilibrium	**6**
Torque	
Define torque and identify its units	
Compute the torque generated by a force about an axis	
Moments of Inertia	
Determine the moment of inertia of a rigid body about a given axis	
Mechanical Equilibrium	
State the conditions of mechanical equilibrium	
Solve problems involving systems in the state of mechanical equilibrium	
Conservation of Angular Momentum	
State the law of conservation of angular momentum	
Solve problems with conservation of angular momentum	
Total Lecture Hours	**40**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Measurements and Systems of Units	**4**
Scientific Notation	
Systems of Units	
Vectors	
Newton's Law	**7**
Newton's Laws of Motion	
Newton's Universal Law of Gravitation	
Mass and Weight	
Application of Newton's Laws	
Work, Energy and Power	**4**
Work, Energy and Power	
Conservation of Energy	
Work	
Kinetic Energy	

Hooke's Law	
Potential Energy	
Power	
Impulse and Momentum	4
Momentum	
Conservation of Momentum	
Elastic and Inelastic Collisions	
One and Two-Dimensional Motion	7
Displacement	
Velocity and Speed	
Acceleration	
Motion and Constant Acceleration	
Angular Displacement	
Circular Motion	
Mechanical Equilibrium	4
Torque	
Moments of Inertia	
Mechanical Equilibrium	
Conservation of Angular Momentum	
Total Lab Hours	**30**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment
   c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Install Control System Hardware

C. MAINTAIN FIELD INSTRUMENTATION DEVICES

1. Install/Replace Field Sensing Elements

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*

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4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

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   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

DC CIRCUIT ANALYSIS

MAST PROGRAM
COURSE SYLLABUS
DC CIRCUIT ANALYSIS

Lecture hours/week: 4 **Lab hours/week: 3** **Credit hours: 5**

COURSE DESCRIPTION:

Emphasizes knowledge and ability to analyze basic DC circuits. Topics include: units, basic electrical laws, series and parallel circuits, capacitance, an introduction to network analysis and network theorem concepts, and DC instruments. Laboratory work parallels class work.

PREREQUISITE: **College Algebra and Computer Programming Fundamentals**

REQUIRED COURSE MATERIALS:

Textbook: Introductory Circuit Analysis, Boylstad, 5th Edition

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Conversion, Scientific Notation		
Current and Voltage		
Resistance		
Test 1		
Ohm's Law, Power, and Energy		
Series and Parallel Circuits		

Test 2
Review and Midterm
Series Parallel Circuits
Test 3
Network Analysis
Network Theorems
Capacitor
Test 4
Review and Final Exam

Total Lecture Hours **40**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Scientific Notation	3
Measure Voltage and Current, Voltmeter and Ammeter	3
Measure Resistance of Fixed and Variable Resistors	3
Measure Power, Wattmeter	3
Construct Series Circuit; Construct Parallel Circuit; Measure Voltage and Currents in Circuits	3
Construct Series and Parallel Circuits	3
Mesh Analysis	3
Norton's Theorem	3
Measure Capacitor Leakage Current and Charging Current	3
Complete All Labs	3
Total Lab Hours	**30**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment
   c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished

d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Collect and Record Data According to Company Requirements
2. Simulate Control System Check
3. Perform On-Line Testing

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. Information: Acquires and uses information

1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. Systems: Understands complex inter-relationships

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule

c. constantly evaluating the quality of work to achieve acceptable standards
d. maintains record of evaluations and sets individual goals

E. Technology: Works with a variety of technologies

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

*A. **Basic Skills:** Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

*1. **Reading:** Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

*2. **Writing:** Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

*3. **Arithmetic/Mathematics:** Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

*4. **Listening:** Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

*5. **Speaking**: Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill

d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*

a. learns to take pride in his or her work through positive reinforcement
b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

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***T*echnology Program**

MAST

COURSE SYLLABUS

DIFFERENTIAL CALCULUS

MAST PROGRAM
COURSE SYLLABUS
DIFFERENTIAL CALCULUS

Lecture hours/week: 5 **Lab hours/week: 0** **Credit hours: 5**

COURSE DESCRIPTION:

Emphasizes the use of differential calculus. Application of techniques include extreme value problems, motion, graphing, and other topics as time allows. Topics include: derivatives and applications, differentiation of transcendental functions, and an introductions to integration and applications. Class includes lecture, applications and homework to reinforce learning.

PREREQUISITE: **College Trigonometry**

REQUIRED COURSE MATERIALS:

Textbook: Basic Technical Mathematics With Calculus, 6th Ed.

Hand Tools/Quantity Required:

Tools	
Scientific Calculator	1
Graph paper	1 pack
Pencils	
Straight edge	1

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and discussions.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. satisfactorily perform on written, oral, and practical examinations
2. satisfactorily perform on outside assignments including writing assignments
3. contribute to class discussions
4. maintain attendance per current policy

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Functions (Notations, Range, Domain, Inverse, Operations, Graphing, Continuous)	760	5
Test 1		2

Limits	610		5
The Slope of a Tangent to a Curve			
The Derivative			
The Derivative as an Instantaneous Rate of Change			
Derivatives of Polynomials			
Derivatives of Products and Quotients of Functions			
The Derivative of a Power of a Function			
Differentiation of Implicit Functions			
Higher Derivatives			
Derivatives of the Sine and Cosine Functions	760		5
Derivatives of the Other Trigonometric Functions			
Derivative of the Logarithmic Function			
Derivative of the Exponential Functions			
Test 2			2
Tangents and Normals	656		5
Newton's Method for Solving Equations			
Curvilinear Motion			
Related Rates			
Using Derivatives in Curve Sketching			
More on Curve Sketching			
Applied Maximum and Minimum Problems			
Differentials	692		5
Test 3			2
Antiderivatives			
The Indefinite Integral			
The Area Under a Curve			
The Definite Integral			
Applications of the Indefinite Integral	722		5
Areas of Integration			
Other Applications			
Test 4			2
Review for Final Exam			5
Final Exam			2
		Total Lecture Hours	**50**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. ORGANIZE WORK ROUTINES

1. Organize Documents and Drawings Required on the Job
2. Determine Proper Tools/Equipment/Materials to Perform the Job
3. Perform Basic Calculus Operations

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*

1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards

3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** Reads, writes, performs arithmetic and mathematical operations, listens and speaks.

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals

b. identifies actions required to accomplish personal goals

2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic

2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

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*T*echnology Program

MAST

COURSE SYLLABUS

ELECTRICITY AND MAGNETISM

MAST PROGRAM
COURSE SYLLABUS
ELECTRICITY AND MAGNETISM

Lecture hours/week: 4 **Lab hours/week: 3** **Credit hours: 5**

COURSE DESCRIPTION:

The second of three courses in the calculus based physics sequence. This course is an introduction to the classical theory of magnetism. Topics include: electrostatic forces and fields, basic circuit elements and circuit theory, magnetism, electromagnetic waves and modern physics.

PREREQUISITE: **College Trigonometry and Mechanics**

REQUIRED COURSE MATERIALS:

Textbook: University Physics, by William P. Crummet and Author B. Western
Physics of Everyday Phenomena, by W. Thomas Griffith

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Electrostatic Forces and Fields		**10**
Charges		
Identify the units of charge		
Conservation of Charge		

- State the law of conservation of charge

Conductors and Insulators
- Explain and demonstrate the difference between conductors and insulators

Coulomb's Law
- Use Coulomb's law to calculate the force between point charges

Electric Potential
- Compute the potential difference between two points in an electric field

Capacitors
- Define capacitance and identify its units
- Calculate the capacitance of two parallel plates

Magnetism **10**

Magnetic Fields
- Define the concepts of a magnetic field and identify the units of the magnetic field
- Determine the magnitude and direction of the magnetic field produced by straight wires, loops and solenoids

Magnetic Forces
- Explain the forces related to charge in motion

Manual and Self-Inductance
- Calculate the magnitude and direction of an induced EMF using Faraday's law and Lenz's law

Generators and Transformers
- State the principles associated with the behavior of motors and generators
- Explain the principles associated with the behavior of transformers

Circuit Elements and Theory **10**

Direct Current Circuits
Ohm's Law
Calculate the current, EMF, and effective resistance of series and parallel circuits
Kirchoff's Rules
Calculate the current at any point and the potential difference between any two points in a circuit using Kirchoff's rules
Alternating Current Circuits
Resistance
Calculate resistance
Reactance
Calculate the reactance
Inductance
Calculate the inductance
Phase Angles
Calculate the phase angles
Capacitance
Calculate the capacitance
Power
Calculate the reactance, impedance, current, voltage, power factor, power, and phase angle in AC circuits

Electromagnetic Waves **10**

Maxwell's Equations
Recognize Maxwell's equations
Electromagnetic Wave Speed
Explain the relationship between the frequency, wavelength, and speed of electromagnetic waves
Electromagnetic Wave Energy
Explain the transport of energy by electromagnetic waves
Electromagnetic Spectrum
List the various types of electromagnetic waves according to their respective wavelengths

Total Lecture Hours **40**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Electrostatic Forces and Fields	**9**
Charges	
Conservation of Charge	
Conductors and Insulators	
Coulomb's Law	
Electric Potential	
Capacitors	
Magnetism	**6**
Magnetic Fields	
Magnetic Forces	
Manual and Self-Inductance	
Lenz's law	
Generators and Transformers	
Circuit Elements and Theory	**9**
Direct Current Circuits	
Ohm's Law	
Kirchoff's Rules	
Alternating Current Circuits	
Resistance	
Reactance	
Inductance	
Phase Angles	
Capacitance	
Power	
Electromagnetic Waves	**6**
Maxwell's Equations	
Electromagnetic Wave Speed	
Electromagnetic Wave Energy	
Electromagnetic Spectrum	
Total Lab Hours	**30**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment
   c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power Tools

a. Identify and understand safe machine operating procedures
b. Demonstrate safe machine operation

4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Collect and Record Data According to Company Requirements
2. Function Check Individual Elements Within Loop
3. Test Different Types of System Modules
4. Simulate Control System Check
5. Perform On-Line Testing

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*
1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*
1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*
1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*
1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social

b. organization of personnel and facilities on the shop floor
c. systematic approach to the mechanical process
d. dimensioning and measurement systems
e. systematic organization of training materials

2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** Reads, writes, performs arithmetic and mathematical operations, listens and speaks.

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction

c. observe laboratory demonstrations
d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student

b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
c. develops an understanding good students know what they are going to do in class and does not waste time
d. develops a fine work-ethic

2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management

5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

AC CIRCUIT ANALYSIS I

MAST PROGRAM
COURSE SYLLABUS
AC CIRCUIT ANALYSIS I

Lecture hours/week: 4 **Lab hours/week: 3** **Credit hours: 5**

COURSE DESCRIPTION:

Emphasizes knowledge and ability to analyze AC circuits. Topics include: magnetism inductance\capacitance, alternating current, AC network theorems, admittance, impedance, phasors, complex power and applications and use of appropriate instruments. Laboratory work parallels class work.

PREREQUISITE: **DC Circuit Analysis and College Trigonometry**

REQUIRED COURSE MATERIALS:

Textbook: Introductory Circuit Analysis, Boylstad, 5th Edition
Introduction to Electric Circuits, Jackson, H. W.

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
AC Network Theorems		6
Thevenin's Theorem		
Analyze complex network		
Thevenin's Theorem		

Norton's Theorem
Analyze a complex network using Norton's Theorem

Admittance 6

Admittance Calculations
Calculate the admittance of an AC circuit

Impedance 6

Impedance Calculations
Calculate the impedance in a complex circuit

Phasors 6

AC Voltage and Current
Calculate voltage and current calculations in an AC circuit using phasor analysis

Complex Power 8

Circuit Reduction
Reduce a complex network to an equivalent circuit using analysis technique

Average Power
Calculate the average power in an AC circuit

Reactive Power
Calculate the reactive power in an AC circuit

Apparent Power
Calculate the apparent power in an AC circuit

Applications and Use of Instruments 8

Voltmeters
Measure AC voltage using a voltmeter

Ammeters
Measure AC current using an ammeter

Oscilloscope
Measure voltage and frequency using an oscilloscope

Total Lecture Hours 40

LAB OUTLINE:

Lab Topics	Contact Hrs.
AC Network Theorems	5

Thevenin's Theorem	
Norton's Theorem	
Admittance	5
Admittance Calculations	
Impedance	5
Impedance Calculations	
Phasors	5
AC Voltage and Current	
Complex Power	5
Circuit Reduction	
Average Power	
Reactive Power	
Apparent Power	
Applications and Use of Instruments	5
Voltmeters	
Ammeters	
Oscilloscope	
Total Lab Hours	**30**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   - a. Assume responsibility for the personal safety of oneself and others
   - b. Develop a personal attitude towards safety
   - c. Interpret safety manual directives
   - d. Comply with established company safety practices
2. Use Protective Equipment
   - a. Wear protective safety clothing as required
   - b. Locate and properly use protective equipment
   - c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power Tools
   - a. Identify and understand safe machine operating procedures
   - b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   - a. Keep work areas clean
   - b. Clean machine/hand tools when work is completed
   - c. Put tools away when work is finished
   - d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Collect and Record Data According to Company Requirements
2. Perform Preventive Maintenance Procedures for Control Devices
3. Test Different Types of System Modules
4. Simulate Control System Check
5. Perform On-Line Testing

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. Information: Acquires and uses information

1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. Systems: Understands complex inter-relationships

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. Technology: Works with a variety of technologies

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
3. maintains and troubleshoots equipment

a. applies appropriate preventative maintenance
b. when operating machines
c. reports all malfunctions of equipment to supervisor/instructor
d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*

a. studies student laboratory manual
b. interprets blueprints and technical drawings
c. read/studies textbook
d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*

a. outline the steps necessary to perform a mechanical task
b. maintain a lecture notebook
c. submit written responses to chapter question assignments
d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*

a. keeps a running computation of individual grade
b. performs mathematical computations necessary to understand course

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*

a. assimilate classroom instruction
b. interpret and assimilate video instruction
c. observe laboratory demonstrations
d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*

a. participates in classroom discussions
b. organize ideas and communicate specific questions to the instructor
c. verbally affirms understanding of a concept, procedure, or required skill
d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*

a. identifies personal goals
b. identifies actions required to accomplish personal goals

2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*
1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

ELECTRONIC DEVICES

MAST PROGRAM
COURSE SYLLABUS
ELECTRONIC DEVICES

Lecture hours/week: 4 **Lab hours/week: 3** **Credit hours: 5**

COURSE DESCRIPTION:

Introduces the conduction process in semi-conductor materials. Topics include: semi-conductor physics; diodes; biasing; stability; and graphical analysis of bipolar junction transistors and field effect transistors; an introduction to silicon controlled rectifiers; device curve characteristics and related devices with selected applications. Laboratory work parallels class work.

PREREQUISITE: **DC Circuit Analysis, Composition & Rhetoric I, and College Trigonometry**

REQUIRED COURSE MATERIALS:

Textbook: **Introduction to Electronic Devices**
Lab Manual: **Introduction to Electronic Devices**

Hand Tools/Quantity Required:

VOM	1
Scope	1
Hand Tools	Varies
Calculator	1

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Semi-Conductor Physics		8
Atomic Theory for Semi-Conductors		
Determine the number of electrons in each shell for copper, silicon and germanium		
Silicon and Germanium Conduction		
Explain majority and minority current		
PN Junctions		
Explain the depletion region in a PN junction		
Diodes		8
Diode Models		
Draw the model for an ideal and practical diode		
Diode Applications		
Identify clipping and clamping circuits		
Bipolar Junction Transistors		8
PNP and NPN Atomic Characteristics		
Draw the forward and reverse characteristics for a PN junction		
BJT Operation		
Explain the current flow in a BJT		
Draw the symbols for a PNP and a NPN BJT		
Amplifying Action		
Explain how gain is achieved in a transistor		
Circuit Configurations: Common Base (CB), Common Emitter (CE), Common Collector (CC)		
Explain the characteristics for each transistor configuration		
Specification Sheets		
List the maximum ratings for BJTs		
Transistor Biasing		
List the four (4) main types of DC biasing networks		
Field Effect Transistors		8
Junction Field Transistors		

Explain the operation of the junction field effect transistor
JFET Biasing Circuits
Depletion MOSFET Biasing Circuits
Identify the three (3) main DC biasing networks
Enhancing MOSFET Biasing Circuits
Silicon Controlled Rectifiers 4
Thyistor Concepts
Zener Diodes
Diacs and Triacs Circuit Applications
Tunnel Diodes and Unijunction Transistors
Explain the operation of SCRs thyristors, Zener diodes, diacs and triacs, tunnel diodes, and unijunctional transistors
Device Curve Characteristics 4
Device Characteristics Plotting (Using Curve Tracer and Laboratory Equipment)
Draw the input and/or output characteristics for the following devices: BFT, JFET, depletion MOSFET, enhancement MOSFET, SCR, tracer, Zener diode, and regular diode

Total Lecture Hours **40**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Diodes	**15**
Diode Models	
Diode Applications	
Bipolar Junction Transistors	**9**
PNP and NPN Atomic Characteristics	
BJT Operation	
Amplifying Action	
Circuit Configurations: Common Base (CB), Common Emitter (CE), Common Collector (CC)	

Specification Sheets		
Transistor Biasing		
Field Effect Transistors		3
Junction Field Transistors		
JFET Biasing Circuits		
Depletion MOSFET Biasing Circuits		
Enhancing MOSFET Biasing Circuits		
Silicon Controlled Rectifiers		3
Thyistor Concepts		
Zener Diodes		
Diacs and Triacs Circuit Applications		
Tunnel Diodes and Unijunction Transistors		
	Total Lab Hours	**30**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment
   c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Proper Storage of Circuit Boards
2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware

12. Simulate Control System Check
13. Loop-Check Control System
14. Perform On-Line Testing
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. **MAINTAIN FIELD INSTRUMENTATION DEVICES**

1. Test and Clean Video Display Unit
2. Check and Adjust Video Display Unit

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. **COMPETENCIES**

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*
   1. follows a schedule to complete assigned tasks on time
   2. determine the initial cost of materials and "value added" as result of work
   3. complete a stock request form for required material
   4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*
   1. complete assigned responsibilities within the shop floor serving as a member of the team
   2. provide individual assistance/direction to peers as requested
   3. perform work to acceptable levels of quality as required
   4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*
   1. read and interpret blueprints
   2. organize and apply theories of machine tool operation
   3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*
   1. demonstrate knowledge of the following systems:
      a. laboratory organization structure: physical and social
      b. organization of personnel and facilities on the shop floor
      c. systematic approach to the mechanical process
      d. dimensioning and measurement systems
      e. systematic organization of training materials
   2. monitors and corrects performance during
      a. the practical process

b. adjustments of individual laboratory work schedule
c. constantly evaluating the quality of work to achieve acceptable standards
d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor

c. verbally affirms understanding of a concept, procedure, or required skill

d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic

2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

FLUIDS, HEAT, SOUND AND LIGHT

MAST PROGRAM
COURSE SYLLABUS
FLUIDS, HEAT, SOUND, AND LIGHT

Lecture hours/week: 4 **Lab hours/week: 3** **Credit hours: 5**

COURSE DESCRIPTION:

The third of three courses in the calculus based physics sequence. The course is an introduction to the physics of waves, geometrical optics and thermal physics. Laboratory exercises supplement class work. Computer use is an integral part of the class and laboratory assignments.

PREREQUISITE: **Mechanics**

REQUIRED COURSE MATERIALS:

Textbook: University Physics, by William Crummet and Author B. Western

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Statics and Dynamics of Fluids		5
States of Matter		
Define the three states of matter		
Density		
Define density and identify		

its units

Pressure

Define pressure and identify its units

Determine the pressure in a fluid column of known density

Archimedes' Principle

Determine the buoyant force of an object

Bernoulli's Equation

Solve problems with Bernoulli's equation

Heat Transfer 5

Quantity of Heat

Explain the difference between the terms of heat energy and internal energy

Identify the units of heat energy

Calorimetry

Solve calorimetry problems

Thermal Expansion

Solve problems on thermal expansion with the expansion coefficients

Heat Transfer

Explain the three basic avenues of heat transfer

Thermodynamics 5

State Variables

Explain the concept of a state variable

First Law of Thermodynamics

Solve problems using the first law of thermodynamics

Typical Processes in Gases

Explain the four basic thermodynamic processes and the concept of a cyclic thermodynamic process

Demonstrate the use of P-V diagrams

Heat Engines

Define the thermal efficiency

Determine the efficiency of a heat engine

Second Law of Thermodynamics

Explain the second law of thermodynamics

Harmonic Motion 5

Stress

Define stress and identify its units

Calculate stress

Strain

Define strain and identify its units

Moduli of Elasticity

Calculate the moduli of elasticity

Simple Harmonic Motion

Solve problems involving simple harmonic motion

Wave Motion 5

Mechanical Waves

Define the terms used to describe the properties of waves

Reflection of Waves

Explain wave reflection and the principle of superposition

Explain standing waves

Compute wavelength, frequency, and speed of various types of waves

Explain the difference between transverse and longitudinal waves

Sound 5

Sound Waves

Explain the nature of sound as a compressional wave

Intensity

Explain the concepts of intensity and intensity level

Beats

Explain the phenomenon of beats

Resonance

Compute the resonant frequency of a system given appropriate data

Doppler Effect

Explain the Doppler effect and compute frequency shift

given appropriate data

Properties of Light **10**

Speed of Light

Determine the speed of light in various media

Wave-Particle Duality

Demonstrate knowledge of dual nature of light

Reflection

Explain reflection and image formation by plane and spherical mirrors

Refraction

Explain refraction and image formation by lenses

Solve problems using Snell's law

Interface and Diffraction

Explain double slit interference patterns

Explain the behavior of diffraction gratings

Total Lecture Hours **40**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Liquids	3
Temperature and Heat	6
Thermodynamics I	3
Momentum	4
One Dimensional Waves	4
Sound	4
Reflection, Refraction and Polarization of Light	6
Total Lab Hours	**30**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment

c. Use lifting aids when necessary

3. Follow Safe Operating Procedures for Hand and Power Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Proper Storage of Circuit Boards
2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
14. Perform On-Line Testing
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES

1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Test and Calibrate Indicators and Gauges
4. Troubleshoot and Repair Indicators
5. Test and Calibrate Transmitters
6. Test Different Field Sensing Elements
   a. flow
   b. temperature
   c. pressure
   d. level
7. Check and Test Vibration Sensing Elements
8. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves

D. ORGANIZE WORK ROUTINES

1. Organize Documents and Drawings Required on the Job
2. Determine Proper Tools/Equipment/Materials to Perform the Job
3. Verify Equipment Isolation Prior to Performance of Work for Safety Reasons

E. COLLECT AND FILE DATA

1. Record Test/Calibration Data
2. Evaluate Collected Data

F. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES

1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams

3. Learn to Write Technical Reports
4. Utilize Technical Manuals
5. Understand Personal Computers
6. Attend On-Going Safety Training Courses

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*
1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*
1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*
1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*
1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards

d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** Reads, writes, performs arithmetic and mathematical operations, listens and speaks.

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly.

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement

b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Additional Resources:

1. Physics of Everyday Phenomena, by W. Thomas Griffith.
2. University Physics Solutions Manual

PHY291
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*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

AC CIRCUIT ANALYSIS II

MAST PROGRAM
COURSE SYLLABUS
AC CIRCUIT ANALYSIS II

Lecture hours/week: 4 **Lab hours/week: 3** **Credit hours: 5**

COURSE DESCRIPTION:

Continues study of AC circuit analysis which emphasizes transient analysis and network theorems. Topics include: analysis of complex networks, resonance, transformers, multiple sources, three-phase systems, an introduction to filters and bode plots, nonsinusoidal waveforms, and P-Spice.

PREREQUISITE: **AC Circuit Analysis I and Differential Calculus**

REQUIRED COURSE MATERIALS:

Textbook: Introductory Circuit Analysis, Boylstad, 7th Edition
Supplemental Text: Principles of Electric Circuits, T.L. Floyd
Fundamentals of Electric Circuits, David Bell
Introduction to Electric Circuits, Jackson, H.W.

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Series-Parallel AC Networks	Chapter 16 Sections 2, 4, 5, 7, 9, 11, 13	
Methods of Analysis and Selected	Chapter 17	

Topics (Mesh and Nodal)	Sections 3, 5, 7, 8, 11, 17, 22, 27, 28
Network Theorem Norton,	Chapter 18
Thevenin, and Superposition	Sections 3, 5, 7, 10, 11, 13, 27, 37, 38, 44, 46
EXAM 1	
Power (AC) Resistive and Apparent	Chapter 19
Inductive and Reactive	Chapter 19, Sections 1, 3, 4, 6, 8, 12, 15, 18, 20
Series-Parallel Resonance Quality	Chapter 20
Factor Curve	Sections 1, 3, 7, 13, 16, 18, 21, 23, 26
Selectivity Series-Parallel	
EXAM 2	
Attenuation and Bode Plots Low	Chapter 21
Pass, High Pass, Band Pass	Sections 6, 13, 18, 22, 26, 30, 33, 35, 39,
and Band-Stop	42, 47, 49
Polyphase System Y-Delta	Chapter 23
Generators	Sections 4, 7, 9, 13, 17
Non-Sinusoidal Circuits	Chapter 24, Sections 1, 2, 5, 7, 10, 14, 17
Transformers	Chapter 25, Sections 1, 6, 8, 12, 17, 22, 23, 25, 27
FINAL EXAM	
Total Lecture Hours	**40**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Construct AC Ladder Series - Parallel Circuit	3
Construct AC Mesh and Nodal Circuit	3
Construct Norton Network Theorem	3
Construct Thevenin Theorem	3
Measure Apparent, Resistant and Reacting Power	3
Build Resonance Circuits; Measure Quality Factor	3
Build Filters - Low Pass, High Pass, Band Pass, and Band Shop	3
Wire Delta 1 Y-Generators, Measure Voltages	3
Computer Addition of Non-Sinesoidal Waveforms	3
Wire Transformers, Measure Voltage and Impedance	3
Total Lab Hours	**30**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
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2. Use Protective Equipment
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1. Collect and Record Data according to company requirements
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5. Test Different Types of System Modules
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COURSE OBJECTIVES: SCANS COMPETENCIES

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The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*
   1. follows a schedule to complete assigned tasks on time
   2. determine the initial cost of materials and "value added" as result of work
   3. complete a stock request form for required material
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B. ***Interpersonal:*** *Works with others*
   1. complete assigned responsibilities within the shop floor serving as a member of the team
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C. ***Information:*** *Acquires and uses information*
   1. read and interpret blueprints
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D. ***Systems:*** *Understands complex inter-relationships*
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      a. laboratory organization structure: physical and social
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      c. systematic approach to the mechanical process
      d. dimensioning and measurement systems
      e. systematic organization of training materials
   2. monitors and corrects performance during
      a. the practical process
      b. adjustments of individual laboratory work schedule
      c. constantly evaluating the quality of work to achieve acceptable standards
      d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*
   1. chooses procedure, tools and equipment required to perform the task
   2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
   3. maintains and troubleshoots equipment
      a. applies appropriate preventative maintenance
      b. when operating machines
      c. reports all malfunctions of equipment to supervisor/instructor
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   2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
      a. outline the steps necessary to perform a mechanical task
      b. maintain a lecture notebook
      c. submit written responses to chapter question assignments
      d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course
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   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
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   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator

b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

DIGITAL FUNDAMENTALS

MAST PROGRAM
COURSE SYLLABUS
DIGITAL FUNDAMENTALS

Lecture hours/week: 4 **Lab hours/week: 3** **Credit hours: 5**

COURSE DESCRIPTION:

Introduces digital electronics. Topics include: fundamental of digital techniques, integrated logic circuits involving number systems, logic symbols and gates. Boolean algebra, and optimization techniques, flip-flops and registers, combinational and sequential logic circuits, and memory circuits. Laboratory work parallels class work.

PREREQUISITE: **AC Circuit Analysis I**

REQUIRED COURSE MATERIALS:

Textbook: **Digital System Principles & Applications**, Ronald J. Tocci, 6th edition, Prentice Hall (Englewood Cliffs, New Jersey)

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Numbering System	Chapter 1, Sections 2, 3, 6	
Parallel and Serial Transmission		
Numbering System Conversion	Chapter 2, Sections 1 (b, c), 2 (f), 10,	

BCD Code	11(e), 22(b), 25 (i, l, p, q), 28, 33, 34
Parity Method for Error Detection	
Boolean Constants and Variables	Chapter 3, Sections 1, 4, 9, 10, 12, 18,
Truth Tables	26, 34, 37, 44, 46, 48
EXAM 1	
Combination Logic Circuits	Chapter 4, Sections 1 (c, f), 5, 7, 10, 15,
Sum-Of Product	18, 21, 25, 26, 30, 32, 35, 39, 41, 46, 47
Product-Of-Sum	
Karnaugh Map	
EX-OR and Not Exclusive OR Gate	
Flip-Flops and Related Topics	Chapter 5, Sections 1, 3, 5, 7, 10, 13, 16,
Clocked S-C, J-K, D Flip Flop	20, 22, 24, 32, 37, 40, 42, 48, 52, 53
Asynchronous Inputs	
EXAM 2	
Add, Subtract, Divide, and Multiply	Chapter 6, Sections 1 (b, e), 2 (c, e, d),
in Numbering Systems	3 (d), 6 (b), 9 (f, h), 11 (b, d), 14 (b), 17,
BCD Addition	20, 24, 30, 33, 36
1's and 2's Complement System	
Async. And Sync. Counters	Chapter 7, Sections 1, 6, 7, 10, 13, 14, 18,
Up and Down Counters	22, 26, 32, 36, 39, 41, 45, 49, 54
Decoding a Counter	
Registers and Memory	
FINAL	
Total Lecture Hours	**40**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Numbering System	
Parallel and Serial Transmission	
Numbering System Conversion	
BCD Code	
Parity Method for Error Detection	
Boolean Constants and Variables	
Truth Tables	
Combination Logic Circuits	
Sum-Of Product	
Product-Of-Sum	
Karnaugh Map	
EX-OR and Not Exclusive OR Gate	
Flip-Flops and Related Topics	
Clocked S-C, J-K, D Flip Flop	
Asynchronous Inputs	
Add, Subtract, Divide, and Multiply in Numbering Systems	
BCD Addition	
1's and 2's Complement System	
Async. And Sync. Counters	
Up and Down Counters	

Decoding a Counter
Registers and Memory

Total Lab Hours 30

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment
   c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Proper Storage of Circuit Boards
2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
14. Perform On-Line Testing
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES

1. Troubleshoot and Repair Electronic Computing Relays
2. Test and Clean Video Display Unit
3. Check and Adjust Video Display Unit

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. **COMPETENCIES**

- *A.* ***Resources:*** *Identifies, organizes, plans, and allocates resources*
  1. follows a schedule to complete assigned tasks on time
  2. determine the initial cost of materials and "value added" as result of work
  3. complete a stock request form for required material
  4. provide a self-evaluation of performance based on the time and quality of work
- *B.* ***Interpersonal:*** *Works with others*
  1. complete assigned responsibilities within the shop floor serving as a member of the team
  2. provide individual assistance/direction to peers as requested
  3. perform work to acceptable levels of quality as required
  4. works well with all members of the class
- *C.* ***Information:*** *Acquires and uses information*
  1. read and interpret blueprints
  2. organize and apply theories of machine tool operation
  3. perform basic semi-precision and precision layout as necessary
- *D.* ***Systems:*** *Understands complex inter-relationships*
  1. demonstrate knowledge of the following systems:
     a. laboratory organization structure: physical and social
     b. organization of personnel and facilities on the shop floor
     c. systematic approach to the mechanical process
     d. dimensioning and measurement systems
     e. systematic organization of training materials
  2. monitors and corrects performance during
     a. the practical process
     b. adjustments of individual laboratory work schedule
     c. constantly evaluating the quality of work to achieve acceptable standards
     d. maintains record of evaluations and sets individual goals
- *E.* ***Technology:*** *Works with a variety of technologies*
  1. chooses procedure, tools and equipment required to perform the task
  2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
  3. maintains and troubleshoots equipment

a. applies appropriate preventative maintenance
b. when operating machines
c. reports all malfunctions of equipment to supervisor/instructor
d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*

a. studies student laboratory manual
b. interprets blueprints and technical drawings
c. read/studies textbook
d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*

a. outline the steps necessary to perform a mechanical task
b. maintain a lecture notebook
c. submit written responses to chapter question assignments
d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*

a. keeps a running computation of individual grade
b. performs mathematical computations necessary to understand course

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*

a. assimilate classroom instruction
b. interpret and assimilate video instruction
c. observe laboratory demonstrations
d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*

a. participates in classroom discussions
b. organize ideas and communicate specific questions to the instructor
c. verbally affirms understanding of a concept, procedure, or required skill
d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*

a. identifies personal goals
b. identifies actions required to accomplish personal goals

2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly.

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*
1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

***M**achine Tool **A**dvanced **S**kills*
***T**echnology Program*

MAST

COURSE SYLLABUS

ELECTROMECHANICAL DEVICES

MAST PROGRAM
COURSE SYLLABUS
ELECTROMECHANICAL DEVICES

Lecture hours/week: 4 **Lab hours/week: 3** **Credit hours: 5**

COURSE DESCRIPTION:

Introduces eletromechanical devices which are essential control elements in electrical systems. Topics include: fundamentals of electromechanical devices, control elements in electrical circuits, typical devices such as generators and alternators, DC and AC motors and controls, transformers and synchromechanisms. Quantitative analysis of power losses, power factors and efficiencies in DC, single-phase and three phase dynamos are stressed. Laboratory work parallels class work.

PREREQUISITE: **AC Circuit Analysis I**

REQUIRED COURSE MATERIALS:

Textbook: Electric Circuits and DC Machines, by E.C. Lister

Hand Tools/Quantity Required:

Calculator
Screwdrivers (flathead and phillips head)
Diagonal pliers

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Switches, Fuses, Relays and Circuit Breakers		
Test on Switches, Fuses, Relays and Circuit Breakers		
Magnetism and Electromagnetism	Pages 72-90	
Test on Magnetism and Electromagnetism		
Transformers - Principle of Operation, Voltage Ration, Turns Ration, Current Ration, Losses, Efficiency	Pages 210-237	
Solve Problems From Handout		
Test on transformers		
DC Generators - Principles of Operation, Different Types, Characteristics	Pages 91-113	
Solve Problems	Pages 114-116	
Field Trip (near end of quarter)		
Alternators - Principle of Operation, Characteristics, Operating in Parallel (Synchronizing)	Pages 242-257	
Solve Problems From Handout		
Test on Generators and Alternators		
Review of Weeks 1-5		
Midterm		
DC Motors - Principle of Operation, Types, Characteristics, Basic Motor Control Methods	Pages 117-144	
Solve Problems	Pages 146-147	
AC Motors (3-Phase) - Principle of Operation, Types, Power Factor, Slip		
NEMA Classification and Class of Insulation		
Test on DC Motors and 3-Phase AC Motors		
Single-Phase AC Motors - Principle of Operation, Types, Characteristics		
Synchromechanism Systems - Synchrotransmitter, Synchro Receiver		
Simplified Circuits on Synchro Systems		
Test on Single Phase AC Motors and Synchro Systems		
Review		
Final Exam		
	Total Lecture Hours	**40**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Switches Used in Common Control Circuits	
Transformers	
Single Phase AC Motors	
3-Phase Motors	
3-Phase Motors	
Total Lab Hours	**30**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment
   c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Proper Storage of Circuit Boards
2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
14. Perform On-Line Testing

15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. **MAINTAIN FIELD INSTRUMENTATION DEVICES**

1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Adjust Dampers and Positioners
4. Troubleshoot and Adjust Control Drive (Damper)
5. Test and Calibrate Indicators and Gauges
6. Troubleshoot and Repair Indicators
7. Test and Calibrate Transmitters
8. Test and Calibrate Recorders
9. Troubleshoot and Repair Recorders
10. Troubleshoot Linear Variable Differential Transformers
11. Troubleshoot, Repair, and Calibrate Transmitters
12. Test Different Field Sensing Elements
    a. flow
    b. temperature
    c. pressure
    d. level
13. Install/Replace Field Sensing Elements
14. Troubleshoot and Repair Transmitters
15. Tune Controllers: Pneumatic and Electronic
16. Troubleshoot and Repair Plant Computing Systems Relating to Process Controls
17. Troubleshoot and Repair Solenoid Valves
18. Perform Preventive Maintenance Procedures for Field Devices
19. Test and Repair Thermocouples
20. Check and Test Vibration Sensing Elements
21. Inspect and Troubleshoot Power Supplies and Converters
22. Test and Calibrate Control Valve Actuators
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24. Test and Calibrate Controllers
25. Troubleshoot and Repair Local Controllers
26. Troubleshoot and Repair Electronic Computing Relays
27. Troubleshoot and Repair Analyzers
28. Test and Calibrate Air Analyzers
29. Test and Calibrate Water Analyzers
30. Troubleshoot Servo Valves
31. Calibrate Servo Valves
32. Test and Clean Video Display Unit
33. Check and Adjust Video Display Unit
34. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves
35. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward
36. Test and Calibrate Gas Analyzers

D. **PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES**

1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams
3. Study Technical Equipment Information
4. Application of ISA/JIC Standards

5. Understand Proper Use of Test Equipment and Tools
6. Learn to Write Technical Reports
7. Acquire Safe Practices for Handling Hydraulic and Special Tools
8. Utilize Technical Manuals
9. Understand Personal Computers
10. Attend On-Going Safety Training Courses
11. Participate in Plant Related Training
12. Attend PLC Training
13. Attend DCS Training

E. MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES

1. Learn to Review and Forecast Spare Parts Inventory
2. Prepare Parts Request
3. Verify Parts Received
4. Research/Verify Substitute Specifications

F. TROUBLESHOOT, INSTALL, MAINTAIN AND OPERATE MOTOR CONTROL SYSTEMS

1. Troubleshoot, Install, Maintain, and Operate Motor Starters
2. Troubleshoot, Install, Maintain, and Operate Relays
3. Troubleshoot, Install, Maintain, and Operate Pushbuttons
4. Troubleshoot, Install, Maintain, and Operate Switches
5. Troubleshoot, Install, Maintain, and Operate PLC Systems, i.e., PLC and DCS Networks

COURSE OBJECTIVES: SCANS COMPETENCIES

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   b. when operating machines
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   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
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   b. performs mathematical computations necessary to understand course
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   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
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   d. accepts responsibility
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   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator

b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. nderstand the consequences of unethical behaviors

***M**achine Tool **A**dvanced **S**kills*
***T**echnology Program*

MAST

COURSE SYLLABUS

CONTROL SYSTEMS

MAST PROGRAM
COURSE SYLLABUS
CONTROL SYSTEMS

Lecture hours/week: 4 **Lab hours/week: 3** **Credit hours: 5**

COURSE DESCRIPTION:

Introduces control system components and theory as they relate to controlling industrial processes. Mechanical, fluidics, temperature, and miscellaneous sensors are studied with emphasis on measuring techniques. Topics include: signal conditioning, and control hardware and actuators. Laboratory work parallel class work.

PREREQUISITE: **Digital Fundamentals**

REQUIRED COURSE MATERIALS:

Textbook: **Instrumentation**, Kirk & Rimboi, American Technical Publishers
Automated Process Control Systems, Hunter, Ronald P.

Lab Manual: Technical Publishing Corporation Books, 111, 112, 113, 221*, 222*, 223*, 230 (*strongly recommended)

Hand Tools/Quantity Required:

Plastic Tool Box
Screwdriver
Pliers
Wrench

COURSE OBJECTIVE:

Upon successful completion of this course, the student will:

1. Describe the advantages and disadvantages of open and closed loop theory in conjunction with level, pressure, flow, temperature and density
2. Describe the features of negative and positive feedback
3. Describe various transducers, i.e., mechanical, electrical
4. Describe various actuators control hardware, i.e., mechanical, electrical

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to Process Control and Level ISA Symbols	Chapters 1 and 4, Appendix A	4
Flow	Chapter 5	4
Measurement and Temperature	Chapter 2	4
Measurements Pressure	Chapter 3	4
Analysis	Chapter 13	4
Analysis Control	Chapter 8	4
Analysis Control, continued		4
Control	Chapter 14	4
(On - Off) - Proportional - + Reset + Derivative,	Chapter 14 continued	4
Review and Final Exam		4
	Total Lecture Hours	**40**

LAB OUTLINE:

Lab Topics		Contact Hrs.
Draw a level control loop		3
Draw a flow control loop		3
Draw a temperature control loop		3
Draw a pressure control loop		3
Draw a density control loop		3
Draw a multi-loop control		15
	Total Lab Hours	**30**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety

c. Interpret safety manual directives
d. Comply with established company safety practices

2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment
   c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Proper Storage of Circuit Boards
2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
14. Perform On-Line Testing
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES

1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Adjust Dampers and Positioners
4. Troubleshoot and Adjust Control Drive (Damper)
5. Test and Calibrate Indicators and Gauges
6. Troubleshoot and Repair Indicators
7. Test and Calibrate Transmitters
8. Test and Calibrate Recorders
9. Troubleshoot and Repair Recorders
10. Troubleshoot Linear Variable Differential Transformers
11. Troubleshoot, Repair, and Calibrate Transmitters
12. Test Different Field Sensing Elements
    a. flow
    b. temperature
    c. pressure
    d. level
13. Install/Replace Field Sensing Elements

14. Troubleshoot and Repair Transmitters
15. Tune Controllers: Pneumatic and Electronic
16. Troubleshoot and Repair Plant Computing Systems Relating to Process Controls
17. Troubleshoot and Repair Solenoid Valves
18. Perform Preventive Maintenance Procedures for Field Devices
19. Test and Repair Thermocouples
20. Check and Test Vibration Sensing Elements
21. Inspect and Troubleshoot Power Supplies and Converters
22. Test and Calibrate Control Valve Actuators
23. Troubleshoot and Repair Control Valves/Positioners
24. Test and Calibrate Controllers
25. Troubleshoot and Repair Local Controllers
26. Troubleshoot and Repair Electronic Computing Relays
27. Troubleshoot and Repair Analyzers
28. Test and Calibrate Air Analyzers
29. Test and Calibrate Water Analyzers
30. Troubleshoot Servo Valves
31. Calibrate Servo Valves
32. Test and Clean Video Display Unit
33. Check and Adjust Video Display Unit
34. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves
35. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward
36. Test and Calibrate Gas Analyzers

D. ORGANIZE WORK ROUTINES

1. Organize Documents and Drawings Required on the Job
2. Determine Proper Tools/Equipment/Materials to Perform the Job
3. Coordinate Work Activities with Other Crafts/Units
4. Coordinate Preventive Maintenance Schedule with Planning Group
5. Verify Equipment Isolation Prior to Performance of Work for Safety Reasons
6. Report Abnormal Equipment Problems to Supervisor
7. Write New Calibration Procedures if Needed
8. Follow Specifications

E. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES

1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams
3. Study Technical Equipment Information
4. Application of ISA/JIC Standards
5. Understand Proper Use of Test Equipment and Tools
6. Learn to Write Technical Reports
7. Acquire Safe Practices for Handling Hydraulic and Special Tools
8. Utilize Technical Manuals
9. Understand Personal Computers
10. Attend on-going Safety Training Courses
11. Participate in Plant Related Training
12. Attend PLC Training
13. Attend DCS Training

F. **MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES**
   1. Learn to Review and Forecast Spare Parts Inventory
   2. Prepare Parts Request
   3. Verify Parts Received
   4. Research/Verify Substitute Specifications

G. **TROUBLESHOOT, INSTALL, MAINTAIN AND OPERATE MOTOR CONTROL SYSTEMS**
   1. Troubleshoot, Install, Maintain, and Operate Motor Starters
   2. Troubleshoot, Install, Maintain, and Operate Relays
   3. Troubleshoot, Install, Maintain, and Operate Pushbuttons
   4. Troubleshoot, Install, Maintain, and Operate Switches
   5. Troubleshoot, Install, Maintain, and Operate PLC Systems, i.e., PLC and DCS Networks

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. **COMPETENCIES**

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*
   1. follows a schedule to complete assigned tasks on time
   2. determine the initial cost of materials and "value added" as result of work
   3. complete a stock request form for required material
   4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*
   1. complete assigned responsibilities within the shop floor serving as a member of the team
   2. provide individual assistance/direction to peers as requested
   3. perform work to acceptable levels of quality as required
   4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*
   1. read and interpret blueprints
   2. organize and apply theories of machine tool operation
   3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*
   1. demonstrate knowledge of the following systems:

a. laboratory organization structure: physical and social
b. organization of personnel and facilities on the shop floor
c. systematic approach to the mechanical process
d. dimensioning and measurement systems
e. systematic organization of training materials

2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction

b. interpret and assimilate video instruction
c. observe laboratory demonstrations
d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly.

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*

a. develops an understanding that in order to be successful you must be a "good" student
b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
c. develops an understanding good students know what they are going to do in class and does not waste time
d. develops a fine work-ethic

2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

MICROCOMPUTER FUNDAMENTALS

MAST PROGRAM
COURSE SYLLABUS
MICROCOMPUTER FUNDAMENTALS

Lecture hours/week: 4 **Lab hours/week: 3** **Credit hours: 5**

COURSE DESCRIPTION:

Continues the study of digital electronics. Topics include: computer arithmetic, analog to digital and digital to analog conversion, microcomputer architecture and machine level and assembly level language programming. Laboratory work parallels class work.

PREREQUISITE: **Electronic Devices and Digital Fundamentals**

REQUIRED COURSE MATERIALS:

Textbook: The 6800 Microprocessor

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Arithmetic and Logic		**8**
Adder Circuits		
Explain the operation of full and half adder circuits		
Encoder/Decoder Circuits		
Explain the operation of		

encoder/decoder circuitry

Conversions	**8**
Digital to Analog	
Construct digital/analog convertors using operational-amplifier summing circuits	
Analyze the operation of current DACs	
Determine the resolution and accuracy of a DAC	
Analog to Digital	
Construct an A/D converter using comparators, D/A convertors, binary counters, and logic gates	
Analyze the operation of a successive approximation ADC	
Microcomputer Architecture	**8**
Tri-State Bus	
Explain how data is transferred between registers connected by a tri-state bus	
System Layout	
Draw a block diagram showing the relationship between system components linked by address, data and control busses	
Machine Level Language Programming	**8**
Machine Code	
Analyze instruction words, data and address words	
Explain how control words activate memory and other registers	
Analyze the operation of program counters, stack registers, instruction registers, and memory address registers	
Analyze read and write operations	
Assembly Level Language Programming	**8**
Assembly Language Codes	
Identify assembly language operation codes	
Write assembly language programs to store and retrieve data	
Total Lecture Hours	**40**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Arithmetic and Logic	**6**
Adder Circuits	
Encoder/Decoder Circuits	
Conversions	**6**
Digital to Analog	
Analog to Digital	
Microcomputer Architecture	**6**
Tri-State Bus	
System Layout	
Machine Level Language Programming	**6**
Machine Code	
Assembly Level Language Programming	**6**
Assembly Language Codes	
Total Lab Hours	**30**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment
   c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Configure Software
2. Troubleshoot and Maintain PLCs and Motor Control Systems

C. COLLECT AND FILE DATA

1. Program PLCs

D. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES

1. Understand Personal Computers
2. Attend PLC Training

E. TROUBLESHOOT, INSTALL, MAINTAIN AND OPERATE MOTOR CONTROL SYSTEMS

1. Troubleshoot, Install, Maintain, and Operate PLC Systems, i.e., PLC and DCS Networks

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. Information: Acquires and uses information

1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. Systems: Understands complex inter-relationships

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards

d. maintains record of evaluations and sets individual goals

E. Technology: Works with a variety of technologies

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.

1. Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
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   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. Writing: Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. Arithmetic/Mathematics: Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

4. Listening: Receives, attends to, interprets, and responds to verbal messages and other cues
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

5. Speaking: Organizes ideas and communicates orally
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement

b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

PROGRAMMABLE CONTROLLERS

MAST PROGRAM
COURSE SYLLABUS
PROGRAMMABLE CONTROLLERS

Lecture hours/week: 3 **Lab hours/week: 3** **Credit hours: 4**

COURSE DESCRIPTION:

Emphasizes an in-depth study of the programmable controller with programming applications involving controlling industrial processes. Topics include: supplies, ladder diagrams, relay logic timers, and counters; Networking is introduced and communications protocol is investigates. Lab work parallels class work.

PREREQUISITE: **Digital Fundamentals**
COREQUISITE: **Electromechanical Devices**

REQUIRED COURSE MATERIALS:

Textbook: Technician's Guide to Programmable Logic Controllers, by Cox

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction and Hardware	Chapters 1 and 2	
Basic Concepts	Chapters 3 and 4	
Test 1		
Program Panels and Relay		

Equivalents	Chapters 5 and 6
Test 2	
Timers, Counters, and Data Manipulation	Chapters 8, 9, 10, 11, 12, 13 and 14
Test 3	
User Program and Editing Functions	
Test 4	
Coding and Documentation of Program	
Review Program	
Total Lecture Hours	**30**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Identify and List Functions of the Various Sections of a Programmable Controller System, Chapters 1 and 2	
Locate and Identify the Functions of the Various Diagnostic Indicators, Chapters 3 and 4 to page 49	
Assign an Address to Designated Terminals, Chapters 5, 7, 8 and 9	
Identify the Address of Words in Memory, Chapters 10, 11, 12, 13, 14	
Enter Various Rungs Using PC Equipment	
Identify the Various Types of Instructions Using PC Equipment	
Troubleshoot the PC System, MSQD and AB 5/10	
Total Lab Hours	**30**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment
   c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished

d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Proper Storage of Circuit Boards
2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
14. Perform On-Line Testing
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES

1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Adjust Dampers and Positioners
4. Troubleshoot and Adjust Control Drive (Damper)
5. Test and Calibrate Indicators and Gauges
6. Troubleshoot and Repair Indicators
7. Test and Calibrate Transmitters
8. Test and Calibrate Recorders
9. Troubleshoot and Repair Recorders
10. Troubleshoot Linear Variable Differential Transformers
11. Troubleshoot, Repair, and Calibrate Transmitters
12. Test Different Field Sensing Elements
    a. flow
    b. temperature
    c. pressure
    d. level
13. Install/Replace Field Sensing Elements
14. Troubleshoot and Repair Transmitters
15. Tune Controllers: Pneumatic and Electronic
16. Troubleshoot and Repair Plant Computing Systems Relating to Process Controls
17. Troubleshoot and Repair Solenoid Valves
18. Perform Preventive Maintenance Procedures for Field Devices
19. Test and Repair Thermocouples
20. Check and Test Vibration Sensing Elements
21. Inspect and Troubleshoot Power Supplies and Converters
22. Test and Calibrate Control Valve Actuators
23. Troubleshoot and Repair Control Valves/Positioners
24. Test and Calibrate Controllers
25. Troubleshoot and Repair Local Controllers
26. Troubleshoot and Repair Electronic Computing Relays

27. Troubleshoot and Repair Analyzers
28. Test and Calibrate Air Analyzers
29. Test and Calibrate Water Analyzers
30. Troubleshoot Servo Valves
31. Calibrate Servo Valves
32. Test and Clean Video Display Unit
33. Check and Adjust Video Display Unit
34. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves
35. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward
36. Test and Calibrate Gas Analyzers

D. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES

1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams
3. Study Technical Equipment Information
4. Application of ISA/JIC Standards
5. Understand Proper Use of Test Equipment and Tools
6. Learn to Write Technical Reports
7. Acquire Safe Practices for Handling Hydraulic and Special Tools
8. Utilize Technical Manuals
9. Understand Personal Computers
10. Attend on-going Safety Training Courses
11. Participate in Plant Related Training
12. Attend PLC Training
13. Attend DCS Training

E. MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES

1. Learn to Review and Forecast Spare Parts Inventory
2. Prepare Parts Request
3. Verify Parts Received
4. Research/Verify Substitute Specifications

COURSE OBJECTIVES: SCANS COMPETENCIES

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2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*

1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*

   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook

d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*

a. demonstrate mastery of the basic skills and techniques
b. use these sequential skills to support mastery of new skills
c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly.

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic

2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management

5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times

c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
d. understand the consequences of unethical behaviors

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

MOTOR CONTROLS

MAST PROGRAM
COURSE SYLLABUS
MOTOR CONTROLS

Lecture hours/week: 4 **Lab hours/week: 3** **Credit hours: 5**

COURSE DESCRIPTION:

Emphasizes the principles of motor controls from fractional horse-power to large magnetic starters, including starting polyphase induction, synchronous, wound rotor and direct current motors. Topics includes: Control pilot devices, control circuits and AC reduced voltage starters, three-phase induction, wound rotor and synchronous motor controls, DC motors and solid state motor controls.

PREREQUISITE: **Electromechanical Devices**

REQUIRED COURSE MATERIALS:

Textbook: Industrial Motor Controls, W. Alerich
ETM
Lab Manual: Solid State DC Motor Control Laboratory Manual

Hand Tools/Quantity Required:

VOM	1
Hand Tools	varies

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Three-Phase Circuits Review		
General Principles of Motor Control Fractional Horse-Power Starters		
Magnetic Line Voltage Starters, Control Stations Relays and Contactors		
Test #1		
Timing Devices, Pilot Devices Control Circuits and Symbols, Schematic and Wiring Diagrams, Conversion From Wiring to Schematic		
Test #2		
Diagrams and Basic Control Circuits, Three-Phase Induction Motor		
Midterm		
Single-Phase Induction Motor, Interlocking Methods, Various Reduced Voltage Starting Multi Speed Induction Motors and Their Controls		
Wound Rotor Motor Theory and Operation		
Manual and Automatic Acceleration of Wound Rotor Motor		
Test #3		
Synchronous Motor Theory and Operations		
Synchronous Motor Controls		
DC Motor Theory and Operations		
DC Motor Controls		
Test #4		
Introduction to Solid State Motor Control, Variable Speed DC Drives		
Test #5		
Variable Frequency Speed Control, Static Logic Control		
Review for Final Exam		
	Total Lecture Hours	**40**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Connect a Push-Button Station to Operate a Relay and a Motor	

(Three-wire Control)
(Two Wire Control)
Connect a Selector Switch (Hands-on Automatic) and Pressure Switch
(Substitute Toggle Switch to Operate a Relay and Load)
Connect a Motor Starter with a Start-Stop and a Jog Control Circuit
Using a Control Relay
Connect Two Forward and Two Reverse Control Stations with
Push-button and Auxiliary Contact Interlock
Dismantle a Three Phase Line Starter, Identifying All Parts and
State the Purpose of Each and Reassemble
Speed Control of a DC Motor and Study of its Characteristics
Connect a Diac-SCR Variable Speed DC Drive and Study its
Characteristics
Connect a Diac-Triac Variable Speed DC Drive and Study its
Characteristics
Study the Characteristics of Various Static Logic Control Elements
and Connect Different Control Schemes Using These Schemes
Open Laboratory

Total Lab Hours **30**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment
   c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Proper Storage of Circuit Boards
2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards

6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
14. Perform On-Line Testing
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. **MAINTAIN FIELD INSTRUMENTATION DEVICES**

1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Adjust Dampers and Positioners
4. Troubleshoot and Adjust Control Drive (Damper)
5. Test and Calibrate Indicators and Gauges
6. Troubleshoot and Repair Indicators
7. Test and Calibrate Transmitters
8. Test and Calibrate Recorders
9. Troubleshoot and Repair Recorders
10. Troubleshoot Linear Variable Differential Transformers
11. Troubleshoot, Repair, and Calibrate Transmitters
12. Test Different Field Sensing Elements
    a. flow
    b. temperature
    c. pressure
    d. level
13. Install/Replace Field Sensing Elements
14. Troubleshoot and Repair Transmitters
15. Tune Controllers: Pneumatic and Electronic
16. Troubleshoot and Repair Plant Computing Systems Relating to Process Controls
17. Troubleshoot and Repair Solenoid Valves
18. Perform Preventive Maintenance Procedures for Field Devices
19. Test and Repair Thermocouples
20. Check and Test Vibration Sensing Elements
21. Inspect and Troubleshoot Power Supplies and Converters
22. Test and Calibrate Control Valve Actuators
23. Troubleshoot and Repair Control Valves/Positioners
24. Test and Calibrate Controllers
25. Troubleshoot and Repair Local Controllers
26. Troubleshoot and Repair Electronic Computing Relays
27. Troubleshoot and Repair Analyzers
28. Test and Calibrate Air Analyzers
29. Test and Calibrate Water Analyzers
30. Troubleshoot Servo Valves
31. Calibrate Servo Valves
32. Test and Clean Video Display Unit
33. Check and Adjust Video Display Unit

34. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves
35. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward
36. Test and Calibrate Gas Analyzers

D. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES

1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams
3. Study Technical Equipment Information
4. Application of ISA/JIC Standards
5. Understand Proper Use of Test Equipment and Tools
6. Learn to Write Technical Reports
7. Acquire Safe Practices for Handling Hydraulic and Special Tools
8. Utilize Technical Manuals
9. Understand Personal Computers
10. Attend On-Going Safety Training Courses
11. Participate in Plant Related Training
12. Attend PLC Training
13. Attend DCS Training

E. MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES

1. Learn to Review and Forecast Spare Parts Inventory
2. Prepare Parts Request
3. Verify Parts Received
4. Research/Verify Substitute Specifications

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. Information: Acquires and uses information

1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. Systems: Understands complex inter-relationships

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. Technology: Works with a variety of technologies

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.

1. Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. Writing: Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook

c. submit written responses to chapter question assignments
d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
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B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*

a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

INTRODUCTION TO PROCESS CONTROL

MAST PROGRAM
COURSE SYLLABUS
INTRODUCTION TO PROCESS CONTROL

Lecture hours/week: 2 **Lab hours/week: 6** **Credit hours: 4**

COURSE DESCRIPTION:

Emphasizes the knowledge and skills required to draw and interpret standard ISA drawings. Topics include: instrumentation symbols, loop identification, open-loop control, closed-loop control, single-loop control and multi-loop control.

PREREQUISITE: **Engineering Graphics I**

COREQUISITE: **Fluids, Heat, Sound and Light**

REQUIRED COURSE MATERIALS:

Textbook: Instrumentation, by Kirk and Rimboi
Lab Manual: Instrumentation, by Kirk and Rimboi

Hand Tools/Quantity Required:
Hand Tools
Safety Glasses
Test Equipment
Calibration Equipment

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Instrumentation Symbols		2
Loop Identification		2
Test #1		
Open Loop		2
Test #2		
Closed Loop		2
Single Loop		2
Test #3		
Multiloop		10
	Total Lecture Hours	**20**

LAB OUTLINE:

Lab Topics		Contact Hrs.
Draw a Level Control Loop		6
Draw a Flow Control Loop		6
Draw a Temperature Control Loop		6
Draw a Pressure Control Loop		6
Draw a Density Control Loop		6
Draw a Multi-Loop Control		30
	Total Lab Hours	**60**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment
   c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Proper Storage of Circuit Boards

2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
14. Perform On-Line Testing
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES

1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Adjust Dampers and Positioners
4. Troubleshoot and Adjust Control Drive (Damper)
5. Test and Calibrate Indicators and Gauges
6. Troubleshoot and Repair Indicators
7. Test and Calibrate Transmitters
8. Test and Calibrate Recorders
9. Troubleshoot and Repair Recorders
10. Troubleshoot Linear Variable Differential Transformers
11. Troubleshoot, Repair, and Calibrate Transmitters
12. Test Different Field Sensing Elements
    a. flow
    b. temperature
    c. pressure
    d. level
13. Install/Replace Field Sensing Elements
14. Troubleshoot and Repair Transmitters
15. Tune Controllers: Pneumatic and Electronic
16. Troubleshoot and Repair Plant Computing Systems Relating to Process Controls
17. Troubleshoot and Repair Solenoid Valves
18. Perform Preventive Maintenance Procedures for Field Devices
19. Test and Repair Thermocouples
20. Check and Test Vibration Sensing Elements
21. Inspect and Troubleshoot Power Supplies and Converters
22. Test and Calibrate Control Valve Actuators
23. Troubleshoot and Repair Control Valves/Positioners
24. Test and Calibrate Controllers
25. Troubleshoot and Repair Local Controllers
26. Troubleshoot and Repair Electronic Computing Relays
27. Troubleshoot and Repair Analyzers
28. Test and Calibrate Air Analyzers
29. Test and Calibrate Water Analyzers

30. Troubleshoot Servo Valves
31. Calibrate Servo Valves
32. Test and Clean Video Display Unit
33. Check and Adjust Video Display Unit
34. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves
35. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedfoward
36. Test and Calibrate Gas Analyzers

D. ORGANIZE WORK ROUTINES

1. Organize Documents and Drawings Required on the Job
2. Determine Proper Tools/Equipment/Materials to Perform the Job
3. Coordinate Work Activities with Other Crafts/Units
4. Coordinate Preventive Maintenance Schedule with Planning Group
5. Verify Equipment Isolation Prior to Performance of Work for Safety Reasons
6. Report Abnormal Equipment Problems to Supervisor
7. Write New Calibration Procedures if Needed
8. Follow Specifications

E. COLLECT AND FILE DATA

1. Record Test/Calibration Data
2. Record Preventive Maintenance Data
3. Record Equipment Disconnect Data
4. Evaluate Collected Data
5. Review & Revise Procedures if Needed
6. Write Reports Required by Company
7. Specify Equipment for Control Systems
8. Prepare and Update Specification Forms
9. Write Work Orders
10. Prepare and Update Ladder And/Or Logic Diagrams
11. Program PLCs

F. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES

1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams
3. Study Technical Equipment Information
4. Application of ISA/JIC Standards
5. Understand Proper Use of Test Equipment and Tools
6. Learn to Write Technical Reports
7. Acquire Safe Practices for Handling Hydraulic and Special Tools
8. Utilize Technical Manuals
9. Understand Personal Computers
10. Attend On-Going Safety Training Courses
11. Participate in Plant Related Training
12. Attend PLC Training
13. Attend DCS Training

G. MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES

1. Learn to Review and Forecast Spare Parts Inventory
2. Prepare Parts Request
3. Verify Parts Received

4. Research/Verify Substitute Specifications

H. TROUBLESHOOT, INSTALL, MAINTAIN AND OPERATE MOTOR CONTROL SYSTEMS

1. Troubleshoot, Install, Maintain, and Operate Motor Starters
2. Troubleshoot, Install, Maintain, and Operate Relays
3. Troubleshoot, Install, Maintain, and Operate Pushbuttons
4. Troubleshoot, Install, Maintain, and Operate Switches
5. Troubleshoot, Install, Maintain, and Operate PLC Systems, i.e., PLC and DCS Networks

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*
1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*
1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*
1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*
1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials

2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions

b. organize ideas and communicate specific questions to the instructor
c. verbally affirms understanding of a concept, procedure, or required skill
d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time

d. develops a fine work-ethic

2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management

5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

CONTROL SYSTEMS II

MAST PROGRAM
COURSE SYLLABUS
CONTROL SYSTEMS II

Lecture hours/week: 4 **Lab hours/week: 3** **Credit hours: 5**

COURSE DESCRIPTION:

This course is designed to develop the skill of the student in the area of Electronic Instrumentation. The course stresses the use of electronic techniques to control industrial processes. The student will develop the skills required to maintain electronic transmitters, recorders, and controllers.

PREREQUISITE: **Control Systems**

REQUIRED COURSE MATERIALS:

Textbook: Automated Process Control Electronic, by Harrington, John

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Safety Industrial Electronics Auxiliary Electrical Devices and Miscellaneous Sensors - Time Measurement Temperature Control - Bridge	Chapters 2, 3, 8, 9	

Networks	Chapters 2, 11	
Review and Midterm		
Pressure Flow	Chapters 5, 7	
Level	Chapter 6	
Analytical Instruments and Controllers	Section 5	
Radiation and Transmission	Chapters 10, 17	
Review and Final Exam		
	Total Lecture Hours	**40**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Personal Protective Equipment	3
Review Solid State Power Supplies	3
Position Sensors - Strain Gauge	3
RTD	3
Bridge	3
Pressure Sensor	3
Float Switch	3
Digital Controller	3
Analog Controller	3
PID Controller	3
Total Lab Hours	**30**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Locate and properly use protective equipment
   c. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Power Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Proper Storage of Circuit Boards

2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
14. Perform On-Line Testing
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES

1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Adjust Dampers and Positioners
4. Troubleshoot and Adjust Control Drive (Damper)
5. Test and Calibrate Indicators and Gauges
6. Troubleshoot and Repair Indicators
7. Test and Calibrate Transmitters
8. Test and Calibrate Recorders
9. Troubleshoot and Repair Recorders
10. Troubleshoot Linear Variable Differential Transformers
11. Troubleshoot, Repair, and Calibrate Transmitters
12. Test Different Field Sensing Elements
    a. flow
    b. temperature
    c. pressure
    d. level
13. Install/Replace Field Sensing Elements
14. Troubleshoot and Repair Transmitters
15. Tune Controllers: Pneumatic and Electronic
16. Troubleshoot and Repair Plant Computing Systems Relating to Process Controls
17. Troubleshoot and Repair Solenoid Valves
18. Perform Preventive Maintenance Procedures for Field Devices
19. Test and Repair Thermocouples
20. Check and Test Vibration Sensing Elements
21. Inspect and Troubleshoot Power Supplies and Converters
22. Test and Calibrate Control Valve Actuators
23. Troubleshoot and Repair Control Valves/Positioners
24. Test and Calibrate Controllers
25. Troubleshoot and Repair Local Controllers
26. Troubleshoot and Repair Electronic Computing Relays
27. Troubleshoot and Repair Analyzers
28. Test and Calibrate Air Analyzers
29. Test and Calibrate Water Analyzers
30. Troubleshoot Servo Valves

31. Calibrate Servo Valves
32. Test and Clean Video Display Unit
33. Check and Adjust Video Display Unit
34. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves
35. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward
36. Test and Calibrate Gas Analyzers

D. ORGANIZE WORK ROUTINES

1. Organize Documents and Drawings Required on the Job
2. Determine Proper Tools/Equipment/Materials to Perform the Job
3. Coordinate Work Activities with Other Crafts/Units
4. Coordinate Preventive Maintenance Schedule with Planning Group
5. Verify Equipment Isolation Prior to Performance of Work for Safety Reasons
6. Report Abnormal Equipment Problems to Supervisor
7. Write New Calibration Procedures if Needed
8. Follow Specifications

E. COLLECT AND FILE DATA

1. Record Test/Calibration Data
2. Record Preventive Maintenance Data
3. Record Equipment Disconnect Data
4. Evaluate Collected Data
5. Review & Revise Procedures if Needed
6. Write Reports Required by Company
7. Specify Equipment for Control Systems
8. Prepare and Update Specification Forms
9. Write Work Orders
10. Prepare and Update Ladder And/Or Logic Diagrams
11. Program PLCs

F. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES

1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams
3. Study Technical Equipment Information
4. Application of ISA/JIC Standards
5. Understand Proper Use of Test Equipment and Tools
6. Learn to Write Technical Reports
7. Acquire Safe Practices for Handling Hydraulic and Special Tools
8. Utilize Technical Manuals
9. Understand Personal Computers
10. Attend On-Going Safety Training Courses
11. Participate in Plant Related Training
12. Attend PLC Training
13. Attend DCS Training

G. MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES

1. Learn to Review and Forecast Spare Parts Inventory
2. Prepare Parts Request
3. Verify Parts Received
4. Research/Verify Substitute Specifications

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*

1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards

3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
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B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

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   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*
1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*

a. assist classmates in improving technical skills
b. assist students with special needs as a peer mentor
c. share laboratory resources (machines, tools and instructor's individual attention)

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management

5. *Integrity/Honesty: Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

DISTRIBUTED CONTROL SYSTEMS

MAST PROGRAM
COURSE SYLLABUS
DISTRIBUTED CONTROL SYSTEMS

Lecture hours/week: 3 **Lab hours/week: 4** **Credit hours: 3**

COURSE DESCRIPTION:

Continues the study of the various applications of distributed control. This course in intended primarily as a survey source of distributed control verses an in-depth study of any single distributed control system. Topics include: historical perspective and systems, basic system wide orientation, sub systems overview, and report generation.

PREREQUISITE: **Control Systems**

REQUIRED COURSE MATERIALS:

Textbook: **Process Control Technician**

Hand Tools/Quantity Required:

Tools	
Safety Glasses	1 pair
Classroom Supplies	1
Calculator	1

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be a "hands-on" process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Control Systems Feedback	1	3
Complex Variable Concepts, Diff. Equations	17	3
Laplace and Z Transforms	22	3
Signal Flow Graphics	67	3
Modeling Electrical and Mechanical Systems Overview	123	3
Stability of Contract Systems, Report Generation	279	3
Time Domain Analysis of Control Systems	307	3
Root-Locus Technique-LAN	398	3
Single Loop, WAN, Distribution Control System	Handouts	3
Multi Loop	Handouts	3
	Total Lecture Hours	**30**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Feedback Lab	4
Variable Concept Problem	4
Laplace Problem	4
Signal Flow Graph Lab	4
Model Electrical System	4
Stability Problem	4
Control System Exercise	4
LAN Lab	4
WAN Lab	4
Multi Loop lab	4
Total Lab Hours	**40**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required

b. Locate and properly use protective equipment
c. Use lifting aids when necessary

3. Follow Safe Operating Procedures for Hand and Power Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials

B. MAINTAIN CONTROL SYSTEMS

1. Proper Storage of Circuit Boards
2. Collect and Record Data According to Company Requirements
3. Test and Calibrate Transducers According to Specs
4. Perform Preventive Maintenance Procedures for Control Devices
5. Test and/or Replace Printed Circuit Boards
6. Function Check Individual Elements Within Loop
7. Troubleshoot Different Types of System Modules
8. Test Different Types of System Modules
9. Configure Software
10. Repair Different Types of System Modules
11. Install Control System Hardware
12. Simulate Control System Check
13. Loop-Check Control System
14. Perform On-Line Testing
15. Troubleshoot and Maintain PLCs and Motor Control Systems

C. MAINTAIN FIELD INSTRUMENTATION DEVICES

1. Test and Calibrate Pressure, Level, Flow, Temperature Switches
2. Troubleshoot and Repair Pressure, Level, Flow, Temperature Switches
3. Adjust Dampers and Positioners
4. Troubleshoot and Adjust Control Drive (Damper)
5. Test and Calibrate Indicators and Gauges
6. Troubleshoot and Repair Indicators
7. Test and Calibrate Transmitters
8. Test and Calibrate Recorders
9. Troubleshoot and Repair Recorders
10. Troubleshoot Linear Variable Differential Transformers
11. Troubleshoot, Repair, and Calibrate Transmitters
12. Test Different Field Sensing Elements
    a. flow
    b. temperature
    c. pressure
    d. level
13. Install/Replace Field Sensing Elements
14. Troubleshoot and Repair Transmitters
15. Tune Controllers: Pneumatic and Electronic

16. Troubleshoot and Repair Plant Computing Systems Relating to Process Controls
17. Troubleshoot and Repair Solenoid Valves
18. Perform Preventive Maintenance Procedures for Field Devices
19. Test and Repair Thermocouples
20. Check and Test Vibration Sensing Elements
21. Inspect and Troubleshoot Power Supplies and Converters
22. Test and Calibrate Control Valve Actuators
23. Troubleshoot and Repair Control Valves/Positioners
24. Test and Calibrate Controllers
25. Troubleshoot and Repair Local Controllers
26. Troubleshoot and Repair Electronic Computing Relays
27. Troubleshoot and Repair Analyzers
28. Test and Calibrate Air Analyzers
29. Test and Calibrate Water Analyzers
30. Troubleshoot Servo Valves
31. Calibrate Servo Valves
32. Test and Clean Video Display Unit
33. Check and Adjust Video Display Unit
34. Specify and Configure Smart Field Devices, i.e., Transmitters and Valves
35. Operate Control Systems Including Single Element, Cascade, Ratio, and Feedforward
36. Test and Calibrate Gas Analyzers

D. ORGANIZE WORK ROUTINES

1. Organize Documents and Drawings Required on the Job
2. Determine Proper Tools/Equipment/Materials to Perform the Job
3. Coordinate Work Activities with Other Crafts/Units
4. Coordinate Preventive Maintenance Schedule with Planning Group
5. Verify Equipment Isolation Prior to Performance of Work for Safety Reasons
6. Report Abnormal Equipment Problems to Supervisor
7. Write New Calibration Procedures if Needed
8. Follow Specifications

E. COLLECT AND FILE DATA

1. Record Test/Calibration Data
2. Record Preventive Maintenance Data
3. Record Equipment Disconnect Data
4. Evaluate Collected Data
5. Review & Revise Procedures if Needed
6. Write Reports Required by Company
7. Specify Equipment for Control Systems
8. Prepare and Update Specification Forms
9. Write Work Orders
10 Prepare and Update Ladder And/Or Logic Diagrams
11 Program PLCs

F. PARTICIPATE IN CONTINUING EDUCATION ACTIVITIES

1. Read/Interpret Diagrams and Drawings
2. Sketch Diagrams

3. Study Technical Equipment Information
4. Application of ISA/JIC Standards
5. Understand Proper Use of Test Equipment and Tools
6. Learn to Write Technical Reports
7. Acquire Safe Practices for Handling Hydraulic and Special Tools
8. Utilize Technical Manuals
9. Understand Personal Computers
10 Attend On-Going Safety Training Courses
11 Participate in Plant Related Training
12. Attend PLC Training
13. Attend DCS Training

G. MAINTAIN AND CONTROL INVENTORY ACCORDING TO COMPANY POLICIES AND PROCEDURES

1. Learn to Review and Forecast Spare Parts Inventory
2. Prepare Parts Request
3. Verify Parts Received
4. Research/Verify Substitute Specifications

H. TROUBLESHOOT, INSTALL, MAINTAIN AND OPERATE MOTOR CONTROL SYSTEMS

1. Troubleshoot, Install, Maintain, and Operate Motor Starters
2. Troubleshoot, Install, Maintain, and Operate Relays
3. Troubleshoot, Install, Maintain, and Operate Pushbuttons
4. Troubleshoot, Install, Maintain, and Operate Switches
5. Troubleshoot, Install, Maintain, and Operate PLC Systems, i.e., PLC and DCS Networks

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material

4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal: Works with others***

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information: Acquires and uses information***

1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. ***Systems: Understands complex inter-relationships***

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology: Works with a variety of technologies***

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*

   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to perform a mechanical task
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments
3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. performs mathematical computations necessary to understand course
4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*
1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*

a. demonstrate mastery of the basic skills and techniques
b. use these sequential skills to support mastery of new skills
c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic

2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken equipment/tools
   c. accept the responsibility for self-management

5. ***Integrity/Honesty:*** *Chooses ethical courses of action*

a. accept the responsibility for own actions
b. exhibit personal honesty at all times
c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
d. understand the consequences of unethical behaviors

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

INTRODUCTORY PSYCHOLOGY

MAST PROGRAM
COURSE SYLLABUS
INTRODUCTORY PSYCHOLOGY

Lecture hours/week: 5 **Lab hours/week: 0** **Credit hours: 5**

COURSE DESCRIPTION:

Emphasizes the basics of psychology. Topics include: science of psychology; social environments; life stages; physiology and behavior; personality; emotions and motives; conflicts, stress, and anxiety; abnormal behavior; and perception, learning, and intelligence.

PREREQUISITE: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: **Exploring Psychology**

METHOD OF INSTRUCTION:

Lecture: Didactic presentations will include lecture and demonstrations.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. satisfactorily perform on written, oral, and practical examinations
2. satisfactorily perform on outside assignments including writing assignments
3. contribute to class discussions
4. maintain attendance per current policy

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Science of Psychology		**10**
Definitions		
Define psychology		
History and Methods		
Identify the founders of the major schools of psychology		
Careers in Psychology		
Describe methods used in psychological research		
Identify career options in		

psychology

Social Environments 10

Definitions

Define social psychology and attitude

Attitudes

Differentiate between types of conformity to social norms

Attribution Theory

Relate attitudes, reputations, and stereotypes to personal perceptions

Identify career options in psychology

Attraction

Describe factors that link attraction and liking

Conformity, Compliance, Obedience, Altruism, and Individualism

Describe how the attribution theory explains behavior and some of its errors

Communications

Identify the four main factors in the communication process

Group Processes

Differentiate between verbal and nonverbal communication

Provide examples of the use of effective and ineffective communications

Practice active listening and non-judgmental paraphrasing of statements

Define personal space and tell how it affects behavior

List factors in group effectiveness

List stages of group performance

Life Stages 10

Physical Development

Identify stages of growth and development throughout life span

Moral Development

Identify theories of moral

development
Cognitive Development
Identify theories of cognitive development

Physiology and Behavior	**10**

Nervous and Endocrine Systems
Define roles of the nervous and endocrine systems of behavior
Altered States of Consciousness
Identify altered states of consciousness

Personality	**10**

Definitions
Define personality
Theories
Match major theorists with their schools of psychology
Careers in Psychology
Describe methods used in psychological research
Identify career options in psychology

Total Lecture Hours	**50**

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of work
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. perform work to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*

1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the mechanical process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the practical process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to perform the task
2. applies appropriate procedures and uses appropriate tools and equipment to perform the mechanical task to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of equipment and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** Reads, writes, performs arithmetic and mathematical operations, listens and speaks.

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*

   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and task completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*

   a. outline the steps necessary to perform a mechanical task

b. maintain a lecture notebook
c. submit written responses to chapter question assignments
d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
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   c. balances social and academic life/responsibilities
   d. accepts responsibility

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   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

APPENDIX A - INDUSTRY COMPETENCY PROFILES

The following pages contain the individual Competency Profiles for each of the companies surveyed by the MAST development center for the occupational specialty area of . These Competency Profiles/skill standards were used to develop the curriculum for the pilot program.

The participation of the companies as partners in the MAST effort is greatly appreciated. Each company has approved the use of its logo in MAST materials. None of the participating companies shall be held responsible or liable for any of the findings of the project.

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Knowledge of Cutting Fluids/Lubricants
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

TEXAS STATE TECHNICAL COLLEGE WACO
MAST PROGRAM REPRESENTATIVES

DR. HUGH ROGERS
Director

DR. JON BOTSFORD
Assistant Director

TERRY SAWMA
Research Coordinator

WALLACE PELTON
Site Coordinator

ROSE MARY TIMMONS
Senior Secretary/Statistician

ALCOA REPRESENTATIVES

MICHAEL L. VIDRINE, P.E.
Central Engineering & Maintenance Service Superintendent

JIM FOSTER
Electrician

Texas State Technical College Waco

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

Electrician's Tools (lineman pliers, wire strippers, screwdrivers, etc.)
Electric Drills and Saws
Conduit Threading Equipment
Measuring Tools
Volt-Ohm-Meters
Tachometers
Amp Meters (Clamp On)
Power Supplies
Oscilloscopes
Signal Generators
Power Distribution Center
Computers
Basic Drafting Tools
Electrical Lighting Equipment
Electrical Switches
Electro-Mechanical Devices (Control Relays, Timers, Contactors, Motor Starters, etc.)
Manual and Hydraulic Conduit Benders
Electrical Panelboards
Hazardous Location Equipment
Wire Pulling Equipment
AC Motors
DC Motors
Servo Motors
Alternators and Generators
Motor/Generator Logic Controllers
Transits
Transformers
Transformer Test Sets
Motor Control Center
Motor Control Troubleshooting Trainers
Switchgear
Protective Metering and Relaying Test Equipment
AC Drives
DC Drives
Servo Drives

FUTURE TRENDS AND CONCERNS

Advanced Computer Applications
Fiber Optic Controls
Advanced Test Equipment
Robotics
Advanced Metering Control

COMPETENCY PROFILE
Electrician/Instrument

Prepared By
M.A.S.T.
Machine Tool Advanced Skills
Technology Program
and
Consortia Partners
(V.199J40008)

Texas State Technical College Waco

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ELECTRICIAN/INSTRUMENT....uses knowledge and skills to install, maintain, and troubleshoot electrical/electronic equipment in residential, commercial, and industrial environments.

Duties	Tasks												
A Practice Electrical Safety	A-1 Keep one hand free when possible	A-2 Wear designated safety equipment	A-3 Use tag, lock and try procedures	A-4 Maintain CPR certification	A-5 When possible, turn off power when testing devices	A-6 Keep metal tools from high voltage areas	A-7 Work with a partner on high voltage jobs	A-8 Practice ladder safety	A-9 Use full protection equipment as requested				
B Perform Basic Mathematical Skills	B-1 Add, subtract, multiply and divide numbers	B-2 Calculate perimeters, areas and volumes	B-3 Use measurement conversion tables	B-4 Solve basic algebraic equations									
C Perform Basic Electrical Functions	C-1 Measure/ calculate DC resistance, current and voltages	C-2 Measure/ calculate power in DC circuits	C-3 Read wire tables and find amperage/ resistance	C-4 Measure/ calculate AC currents, voltages and impedance	C-5 Measure power factor in AC circuits								
D Use Basic Hand and Power Tools	D-1 Measure with inch and metric rulers	D-2 Use screwdrivers, regular and ball peen hammers	D-3 Use crescent wrench, socket drives, lineman pliers	D-4 Use hacksaws, wire stripper, try square, nut driver	D-5 Use tie wrap gun, hex wrenches, channel lock pliers	D-6 Use diagonal cutting pliers, sheet metal snips	D-7 Use hole cutters	D-8 Use drills and reamers					
E Maintain DC Motors	E-1 Use a tachometer to check speed	E-2 Understand difference between series, shunt & compound connected DC motors	E-3 Inspect motor for signs of damage and wear	E-4 Inspect brushes and replace if necessary	E-5 Troubleshoot motors using name plate data	E-6 Disconnect and reconnect motors to the power source	E-7 Identify frame type	E-8 Repair and maintain motor controls					
F Maintain Single Phase Motors	F-1 Use a tachometer to check speed	F-2 Understand types of induction motors, i.e split phase	F-3 Understand types of induction motors, i.e., capacitor start	F-4 Understand types of induction motors, i.e., capacitor run	F-5 Understand types of induction motors, i.e., shaded pole	F-6 Understand types of induction motors, i.e., squirrel cage	F-7 Understand types of induction motors, i.e., wound rotor	F-8 Understand synchronous motor operation	F-9 Inspect motor for signs of damage and wear	F-10 Troubleshoot motors using name plate data	F-11 Disconnect and reconnect motors	F-12 Identify frame and type	F-13 Repair and maintain motor controls
G Maintain Three Phase Motors	G-1 Recognize the Wye and Delta configurations	G-2 Troubleshoot motors using name plate data	G-3 Connect and disconnect motors, including dual voltage nine lead machines	G-4 Identify frame type	G-5 Repair and maintain variable speed drives	G-6 Repair and maintain motor controls							
H Read Basic Blueprints, Drawings and Schematics	H-1 Read circuit diagram schematics	H-2 Read wiring diagrams, including single line diagrams	H-3 Read ladder logic diagrams	H-4 Read digital logic diagrams									
I Use Basic Electrical Metering Equipment	I-1 Use digital and analog ammeters	I-2 Use clamp on ammeters	I-3 Use digital and analog voltmeters or read wattmeters	I-4 Use meggers and insulation testers	I-5 Calibrate and repair electronic scales, loadcells	I-6 Use variable power supplies							
J Test Common Parts and Replace If Necessary	J-1 Test and replace single and three phase contactors	J-2 Test and replace motor starters	J-3 Test and replace overload devices	J-4 Test and replace relays and timers	J-5 Test and replace switches, i.e., SPST/ SPDT/DPST/ DPDT limit	J-6 Test and replace switches, i.e., micro, push button, cam, rotary	J-7 Test and replace switches, i.e., level and flow switches	J-8 Test and replace capacitors, coils, control transformers	J-9 Test and replace starting resistors, wire runs, lights, and switch gear	J-10 Test and replace fuses, circuit breakers and disconnects	J-11 Test and replace diodes, transistors, SCRs	J-12 Test and replace measuring instruments, i.e., varmeters, wattmeters	J-13 Test and replace voltmeters, amp meters

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Duties		Tasks												
K	Maintain Transformers	K-1 Understand basic transformer operation	K-2 Measure transformer voltages and currents	K-3 Test and change transformer oil	K-4 Replace/ repair transformer coils and taps	K-5 Disconnect and connect transformers from the line								
L	Troubleshoot PLCs	L-1 Understand PLC status indicators	L-2 Use PLCs to test input contacts and sensors	L-3 Read PLC line inputs and output conditions	L-4 Read PLC timer, counter information	L-5 Test input and output modules and replace if necessary								
M	Test/Repair Communication Systems	M-1 Test/repair various types of microphones, amplifiers/ speakers	M-2 Maintain RF devices	M-3 Install fiber optic cable	M-4 Install twisted pair cable	M-5 Install coaxial cable	M-6 Maintain video monitor equipment							
N	Understand Basic Troubleshooting Techniques	N-1 Follow power source to final device operation	N-2 Use ohmmeter for continuity checks	N-3 Check voltage/current levels against specification	N-4 Check wiring against diagram	N-5 Analyze possible causes of problem using schematic diagram	N-6 Use isolation to identify problem area							
O	Use Computer	O-1 Calibrate metal sensors	O-2 Operate power system via PC	O-3 Print out data report	O-4 Input data	O-5 Make inquiry via PC	O-6 Search/ clear alarms	O-7 Use E-mail						
P	Install Conduit	P-1 Determine conduit size for the circuit	P-2 Use hand benders to make 90 degree off-sets, etc	P-3 Identify/ use conduit fittings	P-4 Hang and strap conduit	P-5 Make wire pulls in conduit								

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Improvement Activities
Practice Quality-Consciousness in Performance of the Job

CENTRAL FLORIDA COMMUNITY COLLEGE PROGRAM REPRESENTATIVES

DR. HUGH ROGERS
Dean/Technical Education

MIKE FOX
Director/Industry Services

LARRY MYFORD
Coordinator/Manufacturing Technology

DR. ED NIESPODZIANY
Instructor, Electronics Engineering Technology

RICK CUNNINGHAM
Instructor, Electrical Wiring

EMERGENCY ONE, INC. MANAGEMENT TEAM AND EXPERT WORKERS

DAN WOMBOLD, Vice President Human Resources
JIM WHITE, Vice President/Manufacturing
BILL RHODES, Production Manager/Body Plant
RON STEPHENS, Human Resources Manager
ELAINE SWIGART, Human Resources Supervisor
DONNA TACKETT, Health & Safety Supervisor
SCOTT FLINN, Supervisor
JIM OLMSTEAD, Supervisor

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Awareness
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

Electrician's Tools (lineman pliers, wire strippers, screwdrivers, wrenches, etc.)
Electric Drills and Saws
Soldering Guns
Measuring Tools
Volt-Ohm-Meters
Tachometers
Amp Meters (Clamp On)/Power Supplies
Caulking Guns
Wire Crimpers
Wire Wrap Devices
Computers
Basic Drafting Tools
Electrical Lighting Equipment
Electrical Switches
Electro-Mechanical Devices (Controls Relays, Timers, Contactors, Motor Starters, etc.)
Electrical Panelboards
AC Motors
DC Motors
Alternators and Generators
Motor/Generator Logic Controllers
Motor Control Center
Motor Control Troubleshooting Trainers
Switchgear
Protective Metering and Relaying Test Equipment
General Tools (Hacksaws, Sheet Metal Snips, Digonal Cutting Pliers, etc.)

FUTURE TRENDS AND CONCERNS

Advanced Computer Applications
Fiber Optic Controls
Advanced Test Equipment
Robotics
Advanced Metering Control
Reamers
Socket Drives

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COMPETENCY PROFILE

Electrician/Instrument Technician

Prepared by
Central Florida Community College

and
Emergency One, Inc.

December 1995

ELECTRICIAN/INSTRUMENT TECHNICIAN....Uses knowledge and skills to install, maintain, and troubleshoot electrical/electronic equipment in residential, commercial, and industrial environments.

Duties ← **Tasks** →

Duties														
A Practice Electrical Safety	A-1 Demonstrate understanding of safety rules	A-2 Assume personal safety standards for self and others	A-3 Support all safety practices and use protective equipment	A-4 Demonstrate an understanding of proper hazardous material handling	A-5 Know first aid and CPR	A-6 Practice safety in the use of tools	A-7 Wear designated safety equipment (e.g. hard hat, safety glasses)	A-8 Use tag, lock and try procedures on power sources	A-9 Practice ladder safety	A-10 Practice buddy system (i.e., monitoring fellow employees safety)	A-11 Observe precautions during HIPOT insulation	A-12 Observe precautions handling and servicing lead-acid batteries	
B Practice Total Quality	B-1 Apply principles and tools of continuous quality improvement	B-2 Understand the importance of quality in the manufacturing process	B-3 Implement concepts of quality in the workplace	B-4 Follow the Quality Plan and recommend improvements in work methods or tooling	B-5 Establish methods, plans and procedures to maintain quality								
C Work Ethics	C-1 Be prompt and on the job in accordance with work schedule	C-2 Value honest work ethics, dedication, and responsibility in the workplace	C-3 Demonstrate high moral values	C-4 Display a neat and clean workplace	C-5 Practice careful use and maintenance of tools and equipment	C-6 Be committed to excellence and quality	C-7 Present a good company image in attire and attitude	C-8 Support a positive work environment	C-9 Practice a positive attitude				
D Demonstrate Communication Skills	D-1 Be an active listener	D-2 Demonstrate good reading, comprehension, and writing skills	D-3 Be able to document manufacturing procedures	D-4 Be able to prepare recommendations for continuous improvement	D-5 Summarize and prioritize work responsibilities	D-6 Be able to give and follow directions and accept constructive criticism	D-7 Be able to verbally communicate with coworkers and management						
E Work as a Team	E-1 Understand the roles of co-workers	E-2 Respect peer relationships	E-3 Share resources to accomplish necessary tasks	E-4 Facilitate the work ethic by completing tasks accurately and on time	E-5 Be involved with problem solving	E-6 Apply creative thinking	E-7 Support a positive attitude	E-8 Encourage good feelings and morale	E-9 Understand purpose and goals of the organization	E-10 Plan and organize work as a team	E-11 Be willing to lead in areas of knowledge and expertise	E-12 Demonstrate willingness to learn new methods and skills	E-13 Demonstrate good working relationship with others
F Electrical and Mechanical Problem Solving	F-1 Apply addition and subtraction on series circuit calculations	F-2 Apply multiplication and division on parallel circuits and ohms law calculations	F-3 Apply mathematical functions to perform power factor calculations	F-4 Convert fractions-to-decimal and decimal-to-fractions as used on prints	F-5 Apply addition, subtraction, multiplication and division on fractions as used on prints	F-6 Apply addition, subtraction, multiplication and division on decimals as used on prints	F-7 Perform practical mathematical applications relevant to area of work	F-8 Use applied statistics, graphs, and charts for purposes of analysis and problem-solving					
G Perform Basic Electrical Measurements Including	G-1 Measuring DC resistance, current, voltage and power	G-2 Conducting continuity tests	G-3 Determining electrical polarity	G-4 Measuring AC impedance, current, voltage and power	G-5 Measuring power factor in AC circuits								
H Use Basic Hand and Power Tools	H-1 Measure with inch and metric rulers, calipers and micrometers, tri-square	H-2 Cut with hacksaws, sheet metal snips, wire strippers, diagonal cutting pliers	H-3 Form holes using drills, hole punchers, reamers	H-4 Fasten using screw-drivers, nut drivers, crescent & hex wrenches, socket drivers, lineman and channel	lock pliers, pop rivet & wire wrap guns, variety of hand crimpers, soldering	H-5 Use caulking gun to seal							
I Connect and Insulate Wiring	I-1 Use various wire crimping tools and techniques	I-2 Use correct wire stripping techniques	I-3 Use correct soldering techniques	I-4 Insure correct connector mating	I-5 Install heatshrink insulation	I-6 Identify proper sizing and use of tie-wraps							
J Install and Maintain Motors	J-1 Recognize DC, single-phase and three-phase AC motors	J-2 Understand basic operation of DC, single-phase and three-phase AC motors	J-3 Understand types of single-phase AC motors	J-4 Recognize the Wye and Delta three-phase AC configurations	J-5 Disconnect and reconnect motors to the power source	J-6 Measure Motor Efficiency and Power Factor	J-7 Troubleshoot motors using name plate data	J-8 Identify frame type	J-9 Understand dual voltage nine-lead motor	J-10 Repair and maintain motor controls			

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ELECTRICIAN/INSTRUMENT TECHNICIAN...continued

Duties ← **Tasks** →

Duties													
K Read Graphic Drawings, Including:	K-1 Mechanical drawings, sketches and blueprints	K-2 Electrical block diagrams	K-3 Electrical wiring diagrams, including single-line diagrams	K-4 Electronic schematics containing analog and/or digital devices	K-5 Understand E.S.D. and E.M.I. warnings on documents								
L Use Basic Electrical Metering Equipment	L-1 Use digital and analog meters (e.g., mult, amp, ohm, watt)	L-2 Use clamp on ammeters	L-3 Use meggers and insulation testers	L-4 Use power supply (voltage and current)	L-5 Use automated engine/ transmission diagnostic tool								
M Test Following Commonly used Parts and Replace if Necessary	M-1 Single and three-phase contactors	M-2 Fuses, circuit breakers, inverload devices and disconnects	M-3 Relays and timers	M-4 Switches, i.e., SPST, SPDT, DPST, DPDT, limit, micro, pushbutton, rotary liquid level and flow switches	M-5 Capacitors	M-6 Coils, control transformers	M-7 Starting resistors	M-8 Wire runs	M-9 Lights	M-10 Switch gear	M-11 Solid State Devices (e.g., diodes, transistors, SCRs, Triacs)	M-12 Measuring instruments (e.g., voltmeter, ammeter, varmeter, wattmeter)	M-13 Observe appropriate E.S.D. and/or E.M.I. precautions during testing
N Use PLCs	N-1 Understand PLC status indicators	N-2 Use PLCs to test input contacts and sensors	N-3 Read PLC line input/output conditions	N-4 Read PLC timer, counter information	N-5 Test input/ output modules and replace if necessary								
O Install, Test and Maintain Following Electronic Devices	O-1 Amplifier systems	O-2 Micro-phones and speakers	O-3 RF communication devices (e.g., transceivers)	O-4 Coaxial cables and antenna systems	O-5 Video monitor equipment	O-6 Fiber-optic cable (as used in distributive lighting terminations)							
P Understand Basic Trouble-shooting Techniques	P-1 Follow power source to load devices	P-2 Use ohm-meter for continuity checks	P-3 Check voltage/current levels against specification	P-4 Check actual wiring against diagram	P-5 Analyze possible causes of problem using schematic diagram	P-6 Use wire insulation to localize problem area	P-7 Take appropriate E.S.D. and/or E.M.I. precautions during testing						
Q Use P.C./ Microprocessor Based Test Equipment	Q-1 Input data	Q-2 Print out data report	Q-3 Make data base inquiry	Q-4 Conduct problem search and clear alarms									
R Install Flexible Conduit	R-1 Determine conduit size for circuit	R-2 Hang and strap conduit	R-3 Make wire pulls in conduit	R-4 Identify proper sizing and use of tie-wraps									
S Batteries	S-1 Understand precautions to take when handling, installing and servicing batteries	S-2 Check and maintain batteries	S-3 Understand importance of good conductivity of terminals	S-4 Understand series and parallel connections of batteries	S-5 Understand importance of grounds on fixtures	S-6 Understand charging and discharging cycles of batteries	S-7 Understand reserve minutes						
T Read Code Books, Data Handbooks & Working Documents	T-1 Reference and comprehend appropriate Wire Tables	T-2 Reference and comprehend amperage/resistance ratings	T-3 Reference and comprehend N E C Code Book	T-4 Reference and comprehend N F P A Code Book	T-5 Read and comprehend work order specifications	T-6 Read and comprehend forms used to document work completed							

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ELECTRICIAN/INSTRUMENT TECHNICIAN...continued

Duties ← **Tasks** →

U	Emergency Vehicle Terminology	U-1 Display a general understanding of emergency vehicle terminology	U-2 Understand the functions of equipment being assembled	U-3 Understand how components related as a total system									
V	Wellness/ Physical Abilities	V-1 Demonstrate ability to lift 50 pounds	V-2 Demonstrate ability to tolerate heights up to 100 feet	V-3 Ability to work from various positions while standing on concrete for extended periods	V-4 Display ability to work in hot/cold environment for 8-10 hours	V-5 Present a history of documented regular attendance at work	V-6 Apply wellness information to lifestyle to maintain health						

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Knowledge of Cutting Fluids/Lubricants
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

TEXAS STATE TECHNICAL COLLEGE WACO
MAST PROGRAM REPRESENTATIVES

DR HUGH K ROGERS
Director

DR JON BOTSFORD
Assistant Director

JOE PENICK
Project Coordinator

TERRY SAWMA
Research Coordinator

WALLACE PELTON
Site Coordinator

ROSE MARY TIMMONS
Senior Secretary/Statistician

Furnished By:

MARTY SCHMIDT
Senior Manufacturing Engineer and Systems Design Engineer

MICHAEL KON
Manufacturing Engineer and CNC Systems/Program Engineer

Texas State Technical College Waco

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

Electrician's Tools (lineman pliers, wire strippers, screwdrivers, etc.)
Electric Drills and Saws
Conduit Threading Equipment
Measuring Tools
Volt-Ohm-Meters
Tachometers
Amp Meters (Clamp On)
Power Supplies
Oscilloscopes
Signal Generators
Power Distribution Center
Computers
Basic Drafting Tools
Electrical Lighting Equipment
Electrical Switches
Electro-Mechanical Devices (Control Relays, Timers, Contactors, Motor Starters, etc.)
Manual and Hydraulic Conduit Benders
Electrical Panelboards
Hazardous Location Equipment
Wire Pulling Equipment
AC Motors
DC Motors
Servo Motors
Alternators and Generators
Motor/Generator Logic Controllers
Transits
Transformers
Transformer Test Sets
Motor Control Center
Motor Control Troubleshooting Trainers
Switchgear
Protective Metering and Relaying Test Equipment
AC Drives
DC Drives
Servo Drives

FUTURE TRENDS AND CONCERNS

Advanced Computer Applications
Fiber Optic Controls
Advanced Test Equipment
Robotics
Advanced Metering Control

COMPETENCY PROFILE

Electrician/Instrument

Prepared By
M.A.S.T.
Machine Tool Advanced Skills
Technology Program
and
Consortia Partners
(V.199J40008)

Texas State Technical College Waco

LOCKHEED MARTIN

ELECTRICIAN/INSTRUMENT....uses knowledge and skills to install, maintain, and troubleshoot electrical/electronic equipment in residential, commercial, and industrial environments.

Duties	Tasks												
A Practice Electrical Safety	A-1 Keep one hand free when possible	A-2 Wear designated safety equipment	A-3 Use tag, lock and try procedures	A-4 Maintain CPR certification	A-5 When possible, turn off power when testing devices	A-6 Keep metal tools from high voltage areas	A-7 Work with a partner on high voltage jobs	A-8 Practice ladder safety	A-9 Use full protection equipment as requested				
B Perform Basic Mathematical Skills	B-1 Add, subtract, multiply and divide numbers	B-2 Calculate perimeters, areas and volumes	B-3 Use measurement conversion tables	B-4 Solve basic algebraic equations									
C Perform Basic Electrical Functions	C-1 Measure/ calculate DC resistance, current and voltages	C-2 Measure/ calculate power in DC circuits	C-3 Read wire tables and find amperage/ resistance	C-4 Measure/ calculate AC currents, voltages and impedance	C-5 Measure power factor in AC circuits								
D Use Basic Hand and Power Tools	D-1 Measure with inch and metric rulers	D-2 Use screwdrivers, regular and ball peen hammers	D-3 Use crescent wrench, socket drives, lineman pliers	D-4 Use hacksaws, wire stripper, try square, nut driver	D-5 Use tie wrap gun, hex wrenches, channel lock pliers	D-6 Use diagonal cutting pliers, sheet metal snips	D-7 Use hole cutters	D-8 Use drills and reamers					
E Maintain DC Motors	E-1 Use a tachometer to check speed	E-2 Understand difference between series, shunt & compound connected DC motors	E-3 Inspect motor for signs of damage and wear	E-4 Inspect brushes and replace if necessary	E-5 Troubleshoot motors using name plate data	E-6 Disconnect and reconnect motors to the power source	E-7 Identify frame type	E-8 Repair and maintain motor controls					
F Maintain Single Phase Motors	F-1 Use a tachometer to check speed	F-2 Understand types of induction motors, i.e., split phase	F-3 Understand types of induction motors, i.e., capacitor start	F-4 Understand types of induction motors, i.e., capacitor run	F-5 Understand types of induction motors, i.e., shaded pole	F-6 Understand types of induction motors, i.e., squirrel cage	F-7 Understand types of induction motors, i.e., wound rotor	F-8 Understand synchronous motor operation	F-9 Inspect motor for signs of damage and wear	F-10 Troubleshoot motors using name plate data	F-11 Disconnect and reconnect motors	F-12 Identify frame and type	F-13 Repair and maintain motor controls
G Maintain Three Phase Motors	G-1 Recognize the Wye and Delta configurations	G-2 Troubleshoot motors using name plate data	G-3 Connect and disconnect motors, including dual voltage nine lead machines	G-4 Identify frame type	G-5 Repair and maintain variable speed drives	G-6 Repair and maintain motor controls							
H Read Basic Blueprints, Drawings and Schematics	H-1 Read circuit diagram schematics	H-2 Read wiring diagrams, including single line diagrams	H-3 Read ladder logic diagrams	H-4 Read digital logic diagrams									
I Use Basic Electrical Metering Equipment	I-1 Use digital and analog ammeters	I-2 Use clamp on ammeters	I-3 Use digital and analog voltmeters or read wattmeters	I-4 Use meggers and insulation testers	I-5 Calibrate and repair electronic scales, loadcells	I-6 Use variable power supplies							
J Test Common Parts and Replace If Necessary	J-1 Test and replace single and three phase contactors	J-2 Test and replace motor starters	J-3 Test and replace overload devices	J-4 Test and replace relays and timers	J-5 Test and replace switches, i.e., SPST/ SPDT/DPST/ DPDT limit	J-6 Test and replace switches, i.e., micro, push button, cam, rotary	J-7 Test and replace switches, i.e., level and flow switches	J-8 Test and replace capacitors, coils, control transformers	J-9 Test and replace starting resistors, wire runs, lights, and switch gear	J-10 Test and replace fuses, circuit breakers and disconnects	J-11 Test and replace diodes, transistors, SCRs	J-12 Test and replace measuring instruments, i.e., varmeters, wattmeters	J-13 Test and replace voltmeters, amp meters

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Duties	Tasks												
K Maintain Transformers	K-1 Understand basic transformer operation	K-2 Measure transformer voltages and currents	K-3 Test and change transformer oil	K-4 Replace/ repair transformer coils and taps	K-5 Disconnect and connect transformers from the line								
L Troubleshoot PLCs	L-1 Understand PLC status indicators	L-2 Use PLCs to test input contacts and sensors	L-3 Read PLC line inputs and output conditions	L-4 Read PLC timer, counter information	L-5 Test input and output modules and replace if necessary								
M Test/Repair Communication Systems	M-1 Test/ repair various types of microphones, amplifiers/ speakers	M-2 Maintain RF devices	M-3 Install fiber optic cable	M-4 Install twisted pair cable	M-5 Install coaxial cable	M-6 Maintain video monitor equipment							
N Understand Basic Troubleshooting Techniques	N-1 Follow power source to final device operation	N-2 Use ohmmeter for continuity checks	N-3 Check voltage/current levels against specification	N-4 Check wiring against diagram	N-5 Analyze possible causes of problem using schematic diagram	N-6 Use isolation to identify problem area							
O Use Computer	O-1 Calibrate metal sensors	O-2 Operate power system via P.C.	O-3 Print out data report	O-4 Input data	O-5 Make inquiry via P.C.	O-6 Search/ clear alarms	O-7 Use E-mail						
P Install Conduit	P-1 Determine conduit size for the circuit	P-2 Use hand benders to make 90 degree off-sets, etc.	P-3 Identify/ use conduit fittings	P-4 Hang and strap conduit	P-5 Make wire pulls in conduit	P-6 Machine bend conduit up to four inches							

BASIC SKILLS AND KNOWLEDGE

Ability to Comprehend Written/Verbal Instructions
Ability to Work as Part of a Team
Communication Skills
Converse in the Technical Language of the Trade
Knowledge of Calibration Procedures
Knowledge of Company Policies/Procedures
Knowledge of Company Quality Assurance Activities
Knowledge of Employee/Employer Responsibilities
Knowledge of Occupational Opportunities
Knowledge of Safety Regulations
Mathematical Skills - Algebra & Trig
Mechanical Aptitude
Organizational Skills
Practice Quality-Consciousness in Performance of the Job
Practice Safety in the Workplace
Reading/Writing Skills
Use Inspection Devices
Use Pneumatic & Electronic Measurement Devices

AUGUSTA TECHNICAL INSTITUTE MAST PROGRAM REPRESENTATIVES

DR. JIM WEAVER
Site Administrator
(706) 771-4089

RONNIE LAMBERT
Site Coordinator
(706) 771-4090

WILLIAM BECK
Department Head - Electromechanical Technology
(706) 771-4138

PREM IYER
Instructor - Electromechanical Technology
(706) 771-4144

PAMELA PHILLIPS
Secretary
(706) 771-4090

MARSHA HARRISON
Accounts Manager
(706) 771-4090

AMOCO PERFORMANCE PRODUCTS REPRESENTATIVES

JOE LABORADI
Instrumentation Department Manager

Dr. Twyla Tuten
Training Coordinator

JOE CAMP
Instrumentation Technician

AMTEC

ATTITUDES AND TRAITS

Customer Relations
Dependability
Honesty
Interpersonal Skills
Neatness
Personal Ethics
Physical Ability
Professional
Punctuality
Responsible
Safety Conscientious
Self Motivation
Strong Work Ethic
Trustworthy

EQUIPMENT AND TOOLS

AC Solid State Drives
Air Analyzers
Calibrated Instruments (VOM, Pressure Supply)
Computer
Control Valves/Positioners
Controllers
  P/I, I/P, Single Loop, Multiloop
Dampers
DC Solid State Drives
Digital Training Equipment
Electrical Training Equipment
Gas Analyzers
Gauges (Pressure, Limit, Flow)
Hand Tools
Ice Bath
Instrument Lab
Instrumentation Tech's Tools (Lab Calibrated against standard)
Instrumentation Training Equipment
Linear Variable Differential Transformer
Mass Flowmeters
Personal Safety Equipment
pH Analyzer
Programmable Controllers
Recorders/Indicators
Safety Training Equipment
Spectrometer
Strain Gauges
Transducers
Transmitters
Water Analyzers

CONCERNS AND FUTURE TRENDS

Advanced Computer Applications
Automated Material Handling Equipment
Computer Integrated Manufacturing
Distributed Control Systems
Environmental Concerns
Fiber Optic Controls
Robotics
Statistical Process Control

COMPETENCY PROFILE

INSTRUMENTATION TECHNICIAN

Prepared By
M.A.S.T.
Machine Tool Advanced Skills
Technology Program
and
Consortia Partners
(V.199J40008)

AMTEC

AUGUSTA TECHNICAL INSTITUTE

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INSTRUMENTATION AND CONTROL TECHNICIAN....will be able to troubleshoot, repair, calibrate, specify and commission as required all instrumentation and control components relating to overall power plant operations. This is to include dynamic evaluation, testing, controller tuning, and total system performance evaluations.

Duties	Tasks												
A Practice Safety	A-1 Follow safety manuals and all safety regulations/ requirements	A-2 Use protective equipment	A-3 Follow safe operating procedures for hand and power tools	A-4 Maintain a clean and safe work environment									
B Maintain Control Systems	B-1 Proper storage of Circuit Boards	B-2 Collect and record data according to company requirements	B-3 Test and calibrate Transducers according to Specs	B-4 Perform preventive maintenance procedures for control devices	B-5 Test and/ or Replace Printed Circuit Boards	B-6 Function check individual elements within loop	B-7 Troubleshoot different types of system modules	B-8 Test different types of system modules	B-9 Configure Software	B-10 Repair different types of system modules	B-11 Install control system hardware	B-12 Simulate control system check	B-13 Loop-check control system
	B-14 Perform on-line testing	B-15 Troubleshoot and maintain PLCs and motor control systems											
C Maintain Field Instrumentation Devices	C-1 Test and calibrate pressure,level,flow, and temperature switches	C-2 Troubleshoot and repair pres.,level,flow, & temp. sw.	C-3 Adjust dampers and positioners	C-4 Troubleshoot and adjust control drive (damper)	C-5 Test and calibrate indicators and gauges	C-6 Troubleshoot and repair indicators	C-7 Test and calibrate transmitters	C-8 Test and calibrate recorders	C-9 Troubleshoot and repair recorders	C-10 Troubleshoot linear variable differential transformers	C-11 Troubleshoot, repair, and calibrate transmitters	C-12 Test different field sensing elements-flow,temp,pres,level	C-13 Install/ replace field sensing elements
	C-14 Troubleshoot and repair transmitters	C-15 Tune controllers: pneumatic and electronic	C-16 Troubleshoot and repair plant computing systems relate to process controls	C-17 Troubleshoot and repair solenoid valves	C-18 Perform preventive maintenance procedures for field devices	C-19 Test and repair thermocouple	C-20 Check and test vibration sensing elements	C-21 Inspect and troubleshoot power supplies and converters	C-22 Test and calibrate control valve actuators	C-23 Troubleshoot and repair control valves/ positioners	C-24 Test and calibrate controllers	C-25 Troubleshoot and repair local controllers	C-26 Troubleshoot and repair electronic computing relays
	C-27 Troubleshoot and repair analyzers	C-28 Test and calibrate air analyzers	C-29 Test and calibrate water analyzers	C-30 Troubleshoot servo valves	C-31 Calibrate servo valves	C-32 Test and clean video display unit	C-33 Check and adjust video display unit	C-34 Design, specify and configure smart field devices, i.e., transmitters and valves	C-35 Operate control systems including single element, cascade, ratio, and feedforward	C-36 Test and calibrate gas analyzers			
D Organize Work Routines	D-1 Organize documents and drawings required on the job	D-2 Determine proper tools/ equipment/ materials to perform the job	D-3 Coordinate work activities with other crafts/ units	D-4 Coordinate preventive maintenance schedule with planning group	D-5 Verify equipment isolation prior to performance of work for safety reasons	D-6 Report abnormal equipment problems to supervisor	D-7 Write new calibration procedures if needed	D-8 Follow Specifications	D-9 Perform Algebraic Operations	D-10 Perform Trigonometric Functions	D-11 Perform Calculus Operations		
E Collect and File Data	E-1 Record test/calibration data	E-2 Record preventive maintenance data	E-3 Record equipment disconnect data	E-4 Evaluate collected data	E-5 Review/ revise procedures if needed	E-6 Write reports required by company	E-7 Specify equipment for control systems	E-8 Prepare and update specification forms	E-9 Write work orders	E-10 Prepare and update ladder and/or logic diagrams	E-11 Program PLCs		
F Participate in Continuing Education Activities	F-1 Read/ interpret diagrams and drawings	F-2 Sketch diagrams	F-3 Study technical equipment information	F-4 Application of ISA/IIC standards	F-5 Understand proper use of test equipment and tools	F-6 Learn to write technical reports	F-7 Acquire safe practices for handling hydraulic and special tools	F-8 Utilize technical manuals	F-9 Understand personal computers	F-10 Attend on-going safety training courses	F-11 Participate in plant related training	F-12 Attend PLC training	F-13 Attend DCS training

Duties	Tasks											
G Maintain and Control Inventory	G-1 Learn to review and forecast spare parts inventory	G-2 Prepare parts request	G-3 Verify parts received	G-4 Research/ verify substitute specifications								
H Troubleshoot, Install, Maintain and Operate Motor Control Systems	H-1 Trouble-shoot, install, mmaintain, and operate motor starters	H-2 Trouble-shoot, install, maintain, and operate relays	H-3 Trouble-shoot, install, maintain, and operate pushbuttons	H-4 Trouble-shoot, install, maintain, and operate switches	H-5 Trouble-shoot, install, maintain, and operate PLC systems, i.e. PLC and DCS Networks							

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

FUTURE TRENDS AND CONCERNS

TEXAS STATE TECHNICAL COLLEGE WACO
MAST PROGRAM REPRESENTATIVES

DR. HUGH K. ROGERS
Director

DR. JON BOTSFORD
Assistant Director

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Project Coordinator

TERRY SAWMA
Research Coordinator

WALLACE PELTON
Site Coordinator

ROSE MARY TIMMONS
Senior Secretary/Statistician

Furnished By:

MARTY SCHMIDT
Senior Manufacturing Engineer and Systems Design Engineer

MICHAEL KON
Manufacturing Engineer and CNC Systems/Program Engineer

Texas State Technical College Waco

COMPETENCY PROFILE

Instrumentation and Control Technician

Prepared By
M.A.S.T.
Machine Tool Advanced Skills Technology Program
and
Consortia Partners
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Texas State Technical College Waco

LOCKHEED MARTIN

INSTRUMENTATION AND CONTROL TECHNICIAN....will be able to troubleshoot, repair, calibrate, specify and commission as required all instrumentation and control components relating to overall power plant operations. This is to include dynamic evaluation, testing, controller tuning, and total system performance evaluations.

Duties	Tasks												
A Maintain Control Systems	A-1 Clean printed circuit boards	A-2 Collect and record data	A-3 Test and calibrate I/P module	A-4 Perform preventive maintenance procedures for control devices	A-5 Calibrate printed circuit boards	A-6 Repair printed circuit boards	A-7 Function check individual elements within loop	A-8 Trouble-shoot different types of system modules	A-9 Test different types of system modules	A-10 Configure/modify software	A-11 Repair different types of system modules	A-12 Install control system hardware	A-13 Simulate control system check
	A-14 Loop-check control system	A-15 Perform on-line testing and tuning											
B Maintain Field Instrumentation Devices	B-1 Test and calibrate switches	B-2 Trouble-shoot and repair switches	B-3 Adjust dampers and positioners	B-4 Trouble-shoot and adjust control drive (damper)	B-5 Test and calibrate indicators	B-6 Trouble-shoot and repair indicators	B-7 Test and calibrate transmitters	B-8 Test and calibrate recorders	B-9 Trouble-shoot and repair recorders	B-10 Trouble-shoot linear variable differential transformers	B-11 Calibrate linear variable differential transformer	B-12 Test different field sensing elements	B-13 Install/ replace field sensing elements
	B-14 Trouble-shoot and repair local level monitors	B-15 Trouble-shoot and repair transmitters	B-16 Tune controllers and pneumatic	B-17 Trouble-shoot and repair plant computing relays	B-18 Trouble-shoot and repair solenoid valves	B-19 Perform preventive maintenance procedures for field devices	B-20 Fabricate and manufacture thermo-couples	B-21 Check and test vibration sensing elements	B-22 Inspect and trouble-shoot power supplies and converters	B-23 Test and calibrate control valve actuators	B-24 Trouble-shoot and repair control valves/ positioners	B-25 Test and calibrate controllers	B-26 Tune controllers (electronic)
	B-27 Trouble-shoot and repair local controllers	B-28 Trouble-shoot and repair electronic computing relays	B-29 Trouble-shoot and repair analyzers	B-30 Test and calibrate air analyzers	B-31 Test and calibrate water analyzers	B-32 Trouble-shoot servo valves	B-33 Calibrate servo valves	B-34 Test and clean video display unit	B-35 Clean and trouble-shoot optical TV camera (closed circuit)	B-36 Trouble-shoot and repair H, generator control system			
C Organize Work Routines	C-1 Organize documents and drawings required on the job	C-2 Determine proper tools/ equipment/ materials to perform the job	C-3 Coordinate work activities with other crafts/ units	C-4 Verify equipment isolation prior to performance of work	C-5 Report abnormal equipment problems to supervisor	C-6 Write new procedures							
D Collect and File Data	D-1 Record test/calibration data	D-2 Record preventive maintenance data	D-3 Record equipment disconnect data	D-4 Evaluate collected data	D-5 Review/ revise procedures								
E Participate in Continuing Education Activities	E-1 Read/ interpret diagrams and drawings	E-2 Sketch diagrams	E-3 Study technical equipment information	E-4 Application of ISA/IIS standards	E-5 Understand proper use of test equipment and tools	E-6 Learn to write reports	E-7 Know safe practices for handling hydraulic and special tools	E-8 Utilize technical manuals	E-9 Understand personal computers (PC's)	E-10 Understand basics of fiber optics	E-11 Attend on-going safety training courses	E-12 Participate in power plant related training	
F Maintain and Control Inventory	F-1 Review and forecast spare parts inventory	F-2 Prepare parts request	F-3 Verify parts received	F-4 Research/ verify substitute specifications									

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BASIC SKILLS AND KNOWLEDGE

Ability to Comprehend Written/Verbal Instructions
Ability to Work as Part of a Team
Communication Skills
Converse in the Technical Language of the Trade
Knowledge of Calibration Procedures
Knowledge of Company Policies/Procedures
Knowledge of Company Quality Assurance Activities
Knowledge of Employee/Employer Responsibilities
Knowledge of Occupational Opportunities
Knowledge of Safety Regulations
Mathematical Skills - Algebra & Trig
Mechanical Aptitude
Organizational Skills
Practice Quality-Consciousness in Performance of the Job
Practice Safety in the Workplace
Reading/Writing Skills
Use Inspection Devices
Use Pneumatic & Electronic Measurement Devices

AUGUSTA TECHNICAL INSTITUTE MAST PROGRAM REPRESENTATIVES

DR. JIM WEAVER
Site Administrator
(706) 771-4089

RONNIE LAMBERT
Site Coordinator
(706) 771-4090

WILLIAM BECK
Department Head - Electromechanical Technology
(706) 771-4138

PREM IYER
Instructor - Electromechanical Technology
(706) 771-4144

PAMELA PHILLIPS
Secretary
(706) 771-4090

MARSHA HARRISON
Accounts Manager
(706) 771-4090

NUTRASWEET REPRESENTATIVES

RICH RICHEY
Instrumentation Manager

BOB FORD
Training Manager

TERRY BATES
Team Leader - Instrumentation

ATTITUDES AND TRAITS

Customer Relations
Dependability
Honesty
Interpersonal Skills
Neatness
Personal Ethics
Physical Ability
Professional
Punctuality
Responsible
Safety Conscientious
Self Motivation
Strong Work Ethic
Trustworthy

EQUIPMENT AND TOOLS

AC Solid State Drives
Air Analyzers
Calibrated Instruments (VOM, Pressure Supply)
Computer
Control Valves/Positioners
Controllers
  P/I, I/P, Single Loop, Multiloop
Dampers
DC Solid State Drives
Digital Training Equipment
Electrical Training Equipment
Gas Analyzers
Gauges (Pressure, Limit, Flow)
Hand Tools
Ice Bath
Instrument Lab
Instrumentation Tech's Tools (Lab Calibrated against standard)
Instrumentation Training Equipment
Linear Variable Differential Transformer
Mass Flowmeters
Personal Safety Equipment
pH Analyzer
Programmable Controllers
Recorders/Indicators
Safety Training Equipment
Spectrometer
Strain Gauges
Transducers
Transmitters
Water Analyzers

CONCERNS AND FUTURE TRENDS

Advanced Computer Applications
Automated Material Handling Equipment
Computer Integrated Manufacturing
Distributed Control Systems
Environmental Concerns
Fiber Optic Controls
Robotics
Statistical Process Control

COMPETENCY PROFILE

INSTRUMENTATION TECHNICIAN

Prepared By
M.A.S.T.
Machine Tool Advanced Skills
Technology Program
and
Consortia Partners
(V.199J40008)

AUGUSTA TECHNICAL INSTITUTE

NUTRASWEET

INSTRUMENTATION AND CONTROL TECHNICIAN....will be able to troubleshoot, repair, calibrate, specify and commission as required all instrumentation and control components relating to overall power plant operations. This is to include dynamic evaluation, testing, controller tuning, and total system performance evaluations.

Duties	Tasks												
A Practice Safety	A-1 Follow safety manuals and all safety regulations/ requirements	A-2 Use protective equipment	A-3 Follow safe operating procedures for hand and power tools	A-4 Maintain a clean and safe work environment									
B Maintain Control Systems	B-1 Proper storage of Circuit Boards	B-2 Collect and record data according to company requirements	B-3 Test and calibrate Transducers according to Specs	B-4 Perform preventive maintenance procedures for control devices	B-5 Test and/ or Replace Printed Circuit Boards	B-6 Function check individual elements within loop	B-7 Troubleshoot different types of system modules	B-8 Test different types of system modules	B-9 Configure Software	B-10 Repair different types of system modules	B-11 Install control system hardware	B-12 Simulate control system check	B-13 Loop-check control system
	B-14 Perform on-line testing	B-15 Troubleshoot and maintain PLCs and motor control systems											
C Maintain Field Instrumentation Devices	C-1 Test and calibrate pressure,level,flow, and temperature switches	C-2 Troubleshoot and repair pres.,level,flow, & temp sw.	C-3 Adjust dampers and positioners	C-4 Troubleshoot and adjust control drive (damper)	C-5 Test and calibrate indicators and gauges	C-6 Troubleshoot and repair indicators	C-7 Test and calibrate transmitters	C-8 Test and calibrate recorders	C-9 Troubleshoot and repair recorders	C-10 Troubleshoot linear variable differential transformers	C-11 Troubleshoot, repair, and calibrate transmitters	C-12 Test different field sensing elements-flow,temp,pres,level	C-13 Install/ replace field sensing elements
	C-14 Troubleshoot and repair transmitters	C-15 Tune controllers: pneumatic and electronic	C-16 Troubleshoot and repair plant computing systems relate to process controls	C-17 Troubleshoot and repair solenoid valves	C-18 Perform preventive maintenance procedures for field devices	C-19 Test and repair thermocouple	C-20 Check and test vibration sensing elements	C-21 Inspect and troubleshoot power supplies and converters	C-22 Test and calibrate control valve actuators	C-23 Troubleshoot and repair control valves/ positioners	C-24 Test and calibrate controllers	C-25 Troubleshoot and repair local controllers	C-26 Troubleshoot and repair electronic computing relays
	C-27 Troubleshoot and repair analyzers	C-28 Test and calibrate air analyzers	C-29 Test and calibrate water analyzers	C-30 Troubleshoot servo valves	C-31 Calibrate servo valves	C-32 Test and clean video display unit	C-33 Check and adjust video display unit	C-34 Design, specify and configure smart field devices, i.e., transmitters and valves	C-35 Operate control systems including single element, cascade, ratio, and feedforward	C-36 Test and calibrate gas analyzers			
D Organize Work Routines	D-1 Organize documents and drawings required on the job	D-2 Determine proper tools/ equipment/ materials to perform the job	D-3 Coordinate work activities with other crafts/ units	D-4 Coordinate preventive maintenance schedule with planning group	D-5 Verify equipment isolation prior to performance of work for safety reasons	D-6 Report abnormal equipment problems to supervisor	D-7 Write new calibration procedures if needed	D-8 Follow Specifications	D-9 Perform Algebraic Operations	D-10 Perform Trigonometric Functions	D-11 Perform Calculus Operations		
E Collect and File Data	E-1 Record test/calibration data	E-2 Record preventive maintenance data	E-3 Record equipment disconnect data	E-4 Evaluate collected data	E-5 Review/ revise procedures if needed	E-6 Write reports required by company	E-7 Specify equipment for control systems	E-8 Prepare and update specification forms	E-9 Write work orders	E-10 Prepare and update ladder and/or logic diagrams	E-11 Program PLCs		
F Participate in Continuing Education Activities	F-1 Read/ interpret diagrams and drawings	F-2 Sketch diagrams	F-3 Study technical equipment information	F-4 Application of ISA/IIC standards	F-5 Understand proper use of test equipment and tools	F-6 Learn to write technical reports	F-7 Acquire safe practices for handling hydraulic and special tools	F-8 Utilize technical manuals	F-9 Understand personal computers	F-10 Attend on-going safety training courses	F-11 Participate in plant related training	F-12 Attend PLC training	F-13 Attend DCS training

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Duties	Tasks												
G — Maintain and Control Inventory	G-1 Learn to review and forecast spare parts inventory	G-2 Prepare parts request	G-3 Verify parts received	G-4 Research/ verify substitute specifications									
H — Troubleshoot, Install, Maintain and Operate Motor Control Systems	H-1 Trouble-shoot, install, mmaintain, and operate motor starters	H-2 Trouble-shoot, install, maintain, and operate relays	H-3 Trouble-shoot, install, maintain, and operate pushbuttons	H-4 Trouble-shoot, install, maintain, and operate switches	H-5 Trouble-shoot, install, maintain, and operate PLC systems, i.e., PLC and DCS Networks								

BASIC SKILLS AND KNOWLEDGE

Ability to Comprehend Written/Verbal Instructions
Ability to Work as Part of a Team
Communication Skills
Converse in the Technical Language of the Trade
Knowledge of Calibration Procedures
Knowledge of Company Policies/Procedures
Knowledge of Company Quality Assurance Activities
Knowledge of Employee/Employer Responsibilities
Knowledge of Occupational Opportunities
Knowledge of Safety Regulations
Mathematical Skills - Algebra & Trig
Mechanical Aptitude
Organizational Skills
Practice Quality-Consciousness in Performance of the Job
Practice Safety in the Workplace
Reading/Writing Skills
Use Inspection Devices
Use Pneumatic & Electronic Measurement Devices

AUGUSTA TECHNICAL INSTITUTE
MAST PROGRAM REPRESENTATIVES

DR. JIM WEAVER
Site Administrator
(706) 771-4089

RONNIE LAMBERT
Site Coordinator
(706) 771-4090

WILLIAM BECK
Department Head - Electromechanical Technology
(706) 771-4138

PREM IYER
Instructor - Electromechanical Technology
(706) 771-4144

PAMELA PHILLIPS
Secretary
(706) 771-4090

MARSHA HARRISON
Accounts Manager
(706) 771-4090

SEARLE
REPRESENTATIVES

OWEN GENTRY
Plant Engineer

MEL JONES
Training Specialist

GREGG GODSEY
Team Leader - Instrumentation

ATTITUDES AND TRAITS

Customer Relations
Dependability
Honesty
Interpersonal Skills
Neatness
Personal Ethics
Physical Ability
Professional
Punctuality
Responsible
Safety Conscientious
Self Motivation
Strong Work Ethic
Trustworthy

EQUIPMENT AND TOOLS

AC Solid State Drives
Air Analyzers
Calibrated Instruments (VOM, Pressure Supply)
Computer
Control Valves/Positioners
Controllers
P/I, I/P, Single Loop, Multiloop
Dampers
DC Solid State Drives
Digital Training Equipment
Electrical Training Equipment
Gas Analyzers
Gauges (Pressure, Limit, Flow)
Hand Tools
Ice Bath
Instrument Lab
Instrumentation Tech's Tools (Lab Calibrated against standard)
Instrumentation Training Equipment
Linear Variable Differential Transformer
Mass Flowmeters
Personal Safety Equipment
pH Analyzer
Programmable Controllers
Recorders/Indicators
Safety Training Equipment
Spectrometer
Strain Gauges
Transducers
Transmitters
Water Analyzers

CONCERNS AND FUTURE TRENDS

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Automated Material Handling Equipment
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APPENDIX B - PILOT PROGRAM NARRATIVE

What follows is a narrative of the pilot program which was conducted for this particular occupational specialty.

September 16, 1996

Mr. Wallace Pelton
Site Coordinator
Texas State Technical College
3801 Campus Drive
Waco, TX 76705

Dear Wallace:

Every effort was and is being made to fulfill the expectations of the Machine Tool Advanced Skills Technology (MAST) Program with respect to the pilot program. After reviwing the parameters needed to meet the requirements for the MAST prgram, the following areas were addressed: 1) need of conducting a year pilot program during the school year 1995-1996; 2) need of using two pilot programs at this partnering location; and 3) need for 25 students. The original expectation from Augusta Technical Institute was to conduct industrial assessment, curriculum development, pilot program, student assessment and project deliverables in CADD and CNC technical specialty area. However, after consulting with related curriculum areas at Tech here, local industry, and other MAST partners, it was decided to change our emphasis at Augusta Technical Institute to the Instrumentation and Industrial Maintenance Mechanic technical specialty areas.

We have spent many hours conducting the initial phases of the project for the CNC and CADD technical specialty areas. This change caused us to start the five-step process for Instrumentation and Industrial Maintenance Mechanic this year. This resulted in insufficient time to conduct a high quality pilot program with 25 students for one year (between 1995 and 1996) in Instrumentation and Industrial Maintenance Mechanic specialty areas.

Plans have been implemented to conduct the pilot program during the 1996-1997 school year. Recruiting has begun. The pilot program will be conducted in both Instrumentation and Industrial Maintenance Mechanic curriculum areas. The $6,000 scholarship from MAST will be distributed with $3,000 distributed among 15 Instrumentation students and $3,000 distributed among 15 Industrial Maintenance Mechanic students. Students are applying for the MAST pilot programs now. Industrial assessment and industrial validation have taken place for both Instrumentation and Industrial Maintenance Mechanic areas. Curriculum development is actively under way. Student assessment is written and planned with great care. Project deliverables are being prepared. There is a lot of enthusiasm about the two pilot programs. Augusta Technical Institute is excited about these ventures.

Industrial Maintenance Mechanic is a one-year diploma program; and the pilot program will cover the entire year. The Instrumentation program is a two-year associate degree program. Our emphcais for the pilot program for the Instrumentation curriculum will be on the second year students with a GPA of 2.5 or higher.

Enclosed are an information sheet and application for both the instrumentation and Industrial Maintenance Mechanic pilot programs. Please feel free to call me if you require further information.

Sincerely,

Ronnie Lambert
MAST Site Coordinator - Augusta Technical Institute

MAST Program
INSTRUMENTATION TECHNICIAN

The Machine Tool Advanced Skills Technology (MAST) Program, a U.S. Department of Education sponsored grant funded through the Office of Vocational and Adult Education (award #V199J40008) includes funds for student scholarships. The money will be available for tuition, fees, and books for students. Students applying for scholarships will need to meet our normal entrance requirements as outlined in the Augusta Technical Institute (ATI) catalog. As part of the terms of the scholarship, achievements of each student will be followed as they progress through the curriculum and into the workplace.

We can fund 15 student sin Industrial Maintenance Mechanic and 15 students in Instrumentation Technology. The monetary amount available for each curriculum is $3,000 to be distributed among 15 students. The funds need to be distributed evenly among the 15 students from each curriculum.

MAST Program Application
INSTRUMENTATION TECHNICIAN

Please complete all requested information.

---

1. Name_____ _____ _____
   (Last) (First) (MI)

2. Address_____

3. City_____

4. State_____ 5. Zip Code_____

6. Sex: Male_____ Female_____

For more information:

MAST Program Director
Texas State Technical College
3801 Campus Drive
Waco, TX 76705

(817) 867-4849
FAX (817) 867-3380
1-800-792-8784
http://machinetool.tstc.edu